



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

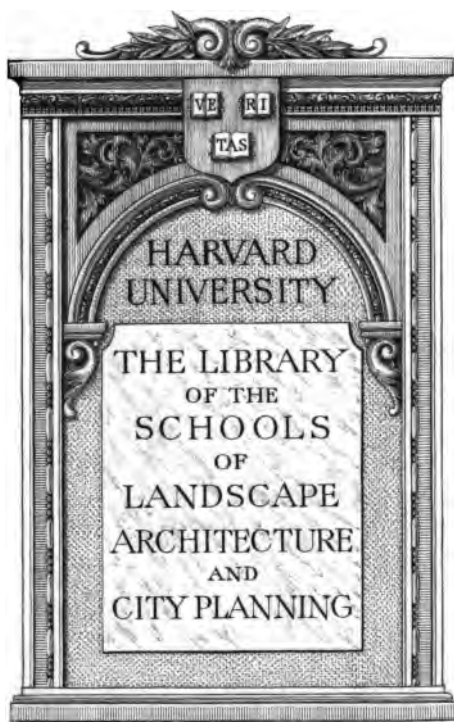
Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

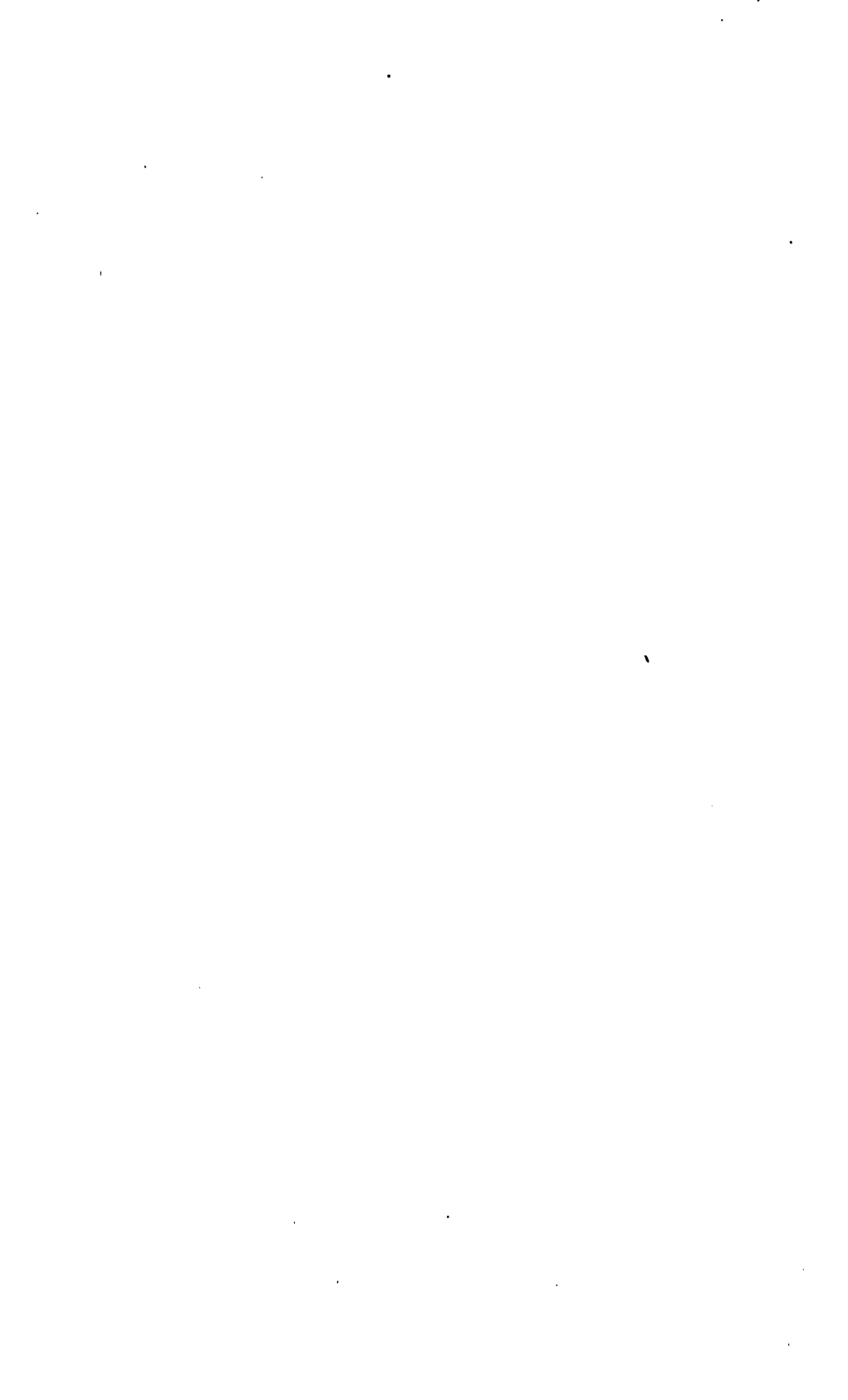
- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>







SEVENTH ANNUAL REPORT

OF THE

MASSACHUSETTS

HIGHWAY COMMISSION.

JANUARY, 1900.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1900.

Sept. 29, 1932

HARVARD UNIVERSITY

The Library of the Schools

of Landscape Architecture and City Planning

Gift of B. W. Pond

7845

HE

355

Mues

1899

C.2

Commonwealth of Massachusetts.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The undersigned commissioners, appointed under the provisions of chapter 476 of the Acts of 1893, entitled "An Act to provide for the appointment of a Highway Commission to improve the public roads, and to define its powers and duties," herewith submit their seventh annual report.

T. C. MENDENHALL.

W. E. McCLINTOCK.

CHARLES W. ROSS.

BOSTON, MASS., Jan. 3, 1900.

LIST OF OFFICERS OF THE MASSACHUSETTS HIGHWAY COMMISSION.

THOMAS CORWIN MENDENHALL,	}	<i>Commissioners.</i>
WILLIAM EDWARD MCCLINTOCK,			
CHARLES WILSON ROSS,			

CHARLES MILLS,	. . . . .	<i>Chief Engineer.</i>
AUSTIN BRADSTREET FLETCHER,	. . . . .	<i>Secretary.</i>

JOHN MICHAEL MCCARTHY,	. . . . .	<i>Clerk,</i>
WALTER EDWIN HITCHCOCK,	. . . . .	<i>Book-keeper,</i>
MARY ALOYSIUS RILEY,	. . . . .	<i>Stenographer,</i>
EDWARD AUGUSTUS AUSTIN,	. . . . .	<i>Messenger.</i>

LOGAN WALLER PAGE,	<i>Geologist,</i>
--------------------	-----------	-------------------



ANNUAL REPORT

OF THE

MASSACHUSETTS HIGHWAY COMMISSION.

In accordance with the provisions of the act of June 17, 1898, appropriating for the construction and maintenance of State highways, \$100,000 became available for the uses of the commission on Jan. 1, 1899. On May 24, 1899, the sum of \$500,000 was appropriated by the Legislature for the same purpose, and with the condition that \$100,000 should not be available until Jan. 1, 1900. The commission has had, therefore, the sum of \$500,000 which could be used for work during the year. In addition to the \$100,000 held over from the appropriation of last year, considerable sums allotted for expenditure during 1898 were actually disbursed during the current year, unavoidable delays having prevented the completion of several contracts.

Never before since the beginning of the work of the commission has the weather been so favorable for road building as during the past season, and never before has the work laid out for the season been so nearly completed within the year. In the few cases in which the finishing must be postponed until the spring of 1900, the delay has been almost absolutely unavoidable, being due to interruptions that could not be foreseen.

Additional lay-outs were made during the year, amounting to 235,236 feet (44.55 miles), bringing the grand total up to 1,407,077 feet (266.49 miles). The number of miles of road finished during the year was approximately 44, making a total of about 250 miles of completed State highway at the end of the year 1899. On the remaining 16 miles laid out but not completed, the work is largely but not entirely done.

In the report for 1899 the commission referred to the vexatious delays in completing contracts, in spite of earnest and continued efforts to hasten the work, and the causes to which these delays must be attributed were discussed at some length. Although there has been much improvement in this respect during the past year, many of these causes still exist, and are the result of conditions beyond the control of the commission. Some of them can be removed by legislation, which the commission has already recommended in previous reports. Others are incident to the processes by which town and municipal authorities do their share of the work in obtaining damage releases or right of way and in waiving or accepting privilege of contract. The addition of a clause fixing liquidated damages for delay in all contracts during the year has had a wholesome effect, and in some instances damages have been assessed under this clause. While it is extremely desirable that these apparently unnecessary delays should be still further reduced, it is fair to say that, by the exercise of proper care in the occupation of the highway during construction, the actual inconvenience to the travelling public, due to State road building, has been greatly diminished, and it is believed that it has not been serious during the past season.

The fact that actual construction has not been commenced more generally at an earlier date has been attributed by many people to delay on the part of the engineering force of the commission, and some explanation of this delay may be of interest. Economy in the administration of the fund appropriated by the State requires that the force employed in the office and in the field should at no time be larger than is actually necessary for the performance of the duties with which the commission is charged. During the road-building season a considerable number of engineers are employed, mostly as inspectors of construction; but during several months of the year they are of no use, and are not retained in the service of the State. A certain number of the most efficient are kept in the employ of the commission during the entire year, and, when not engaged in inspection, are put upon surveys of extensions and new constructions. As the annual appropriation is usually not made until late in June, it is impossible to know the magnitude of the work of the season prior to that

date. It would be bad policy for the commission to keep in its service a large corps of men whose actual employment in construction is necessarily a matter of doubt until after the appropriation is made; and, as a result, several weeks of the best part of the building season are necessarily consumed in completing the preliminary surveys, in making estimates and preparing plans and specifications. Every effort consistent with economy has been made to reduce this delay to a minimum; and the commission has already recommended making appropriations a year in advance of their expenditure, as a means of securing greater promptness and economy in all operations of road building:

In the Appendix to this report will be found a full account in detail of the work done during the year on each of the several roads under construction.

MEETINGS OF THE COMMISSION.

The commission has held 68 meetings at its office in Boston during the past year, besides many others at different points in the State. The regular hearings provided for in the statutes were held, at least one in every county in the State. These hearings have been almost invariably well attended, and there does not seem to be any decrease in interest on the part of the people generally. Important discussions have occurred at these meetings, and many valuable suggestions and timely criticisms have been made, from which the commission has profited much. During the past year the county hearings have developed almost no criticism not entirely friendly to the work, and there exists apparently a much better understanding of the scheme of State road distribution and construction which the commission is attempting to carry out. Especially notable has been the testimony of the value of the work as an incentive to local authorities, and an example which has been much followed in the betterment of highways other than those laid out and built by the State.

In addition to the county hearings, over 240 special hearings, relating to particular petitions, have been held, mostly in the office in Boston. During the winter months these hearings consume a large share of the time of the commission; but they are believed to contribute useful and important information,

upon which the selection of State highways may depend. In the last report reference was made to the practice of sending large numbers of people to represent a town or city in advocating the taking of a certain street as a State highway. In many instances towns have gone to the expense of employing attorneys to speak for them, and conduct a regular examination of witnesses, as before a court. While the commission does not wish to restrict in the least the rights and privileges which local authorities have enjoyed in this respect, it is of opinion that there is often much useless expenditure of money and time in the presentation of the merits of individual petitions. Three or four or five men, well informed as to local conditions and requirements, and having personal knowledge of the importance of the proposed highway, the amount and character of its traffic, etc., will generally make a stronger presentation of the arguments in favor of a petition than would be possible with ten times their number. Ample time could be given to each individual, and there would be little mere repetition of statement. The employment of legal representatives is wholly unnecessary, and local authorities should endeavor to bring to the commission the actual facts relating to the condition and importance of the highway. Upon these facts the commission tries to decide the relative importance of the various roads petitioned for.

CONTRACTS.

In the report for 1899 will be found a somewhat lengthy reference to the difficulties encountered in dealing with contractors who, for one reason or another, suffered considerable loss in carrying out their contracts with the State. In many instances, more especially where the local authorities of a town or city had undertaken to build a road at fixed prices, the commission had been appealed to to make up such loss, either in whole or in part. This the commission declined to do, except on such items of loss as resulted from an error or oversight on the part of the engineering corps. This course has resulted in a greatly improved condition of things in this respect, and the number of requests for relief has been greatly reduced. Towns and cities accepting contracts have improved their business methods, less inefficient labor has been employed, and there

have been fewer instances of the payment of wages in excess of the normal rate.

During the year 77 contracts were entered into, of which 36 were with town or city authorities and 41 with private individuals or firms. The average cost of construction under private or public contract remains, as before, essentially the same.

PETITIONS.

The total number of petitions for the location and construction of State highways up to the issue of this report is 480. Twenty-eight new petitions were received during the year 1899. These petitions cover 1,295 miles of road, and they are from 273 towns and 24 cities. Of the new petitions received during the past year, 23 are from towns and 5 from cities, and they cover 60 miles of road not previously petitioned for. Notwithstanding the removal of the principal obstacle to petitioning, by abolishing the requirement of a preliminary survey, the number of petitions is not yet as great as would be desirable; for, although petitions now on file cover many more miles of road than the State will be likely to lay out during the next several years, an increased number would offer alternative routes, from which a selection might often be made more wisely than at present. Now that the cost of petitioning is practically nothing, a larger freedom of selection ought to be possible.

STREET RAILWAYS.

The rapid extension of electric railway systems, which is not confined to any special locality, has resulted in a considerable increase of street railway mileage on State highway locations. In many cases a street railway has acquired a franchise and a location within the bounds of the public way before the commission has taken it as a State road. In such cases it often happens that in line and grade the street railway is not adjusted to the State highway, and for the safety of the latter a change is required. There has been some uncertainty as to the assessment of the cost of such changes in line and grade of railway tracks when ordered by the commission, legislation regarding the powers and duties of the commission being confusing and somewhat contradictory. The railway is often much benefited by such change; and in any event it appears to the commission

to be a safe general proposition that the Commonwealth should not be subjected to additional expense in the building of a State road by reason of the presence within the bounds of such road of a street railway which enjoys a profitable franchise without cost. This principle easily leads to the practical conclusion that, in the construction of a State highway either contemporaneous with or subsequent to the construction of a street railway within the location of the highway, upon the Commonwealth may be assessed all costs which would have accrued had no railroad existed, and upon the street railway that which grew out of its presence in the highway. Whenever a corporation contemplates the building of a street railway upon a highway which may be in the near future accepted as a location for a State road, the Highway Commission is glad to furnish full information as to probable lines and grades, so that the railway may be put once for all in the proper position, and thus considerable expense saved. The commission has endeavored to co-operate with street railway corporations in all matters of mutual concern, to the end that the real interests of the people shall be conserved; but it is compelled to keep in mind the fact that the State highway is primarily constructed for the free and unrestricted use of all, and that this must be the first consideration in its construction and maintenance.

The right to assess cost of alterations in street railway tracks located upon a State highway upon the railway company, in whole or in part, or upon the Commonwealth, as may be deemed just by the commission, was asserted more than a year ago; and it has been recently affirmed by an opinion of the Attorney-General, the closing paragraph of which is as follows: "Upon the whole, therefore, I am of opinion that your commission, when it orders an alteration in the location of street railway tracks on a State highway, is authorized to assess the expense thereof upon the railway company or upon the Commonwealth (by payment therefor out of its appropriation), or upon both, in such proportion as it may determine."

COUNTY ASSESSMENTS.

In accordance with the provisions of the statutes, the several counties in which State roads are built are required to repay to the State one-quarter of the amount expended during the year.

The time of this repayment may, if desired, extend over six years from the date of the assessment, but in several instances, including some of those in which the amount of the assessment is greatest, counties have preferred to pay the entire sum due at the end of each year. The amount assessed upon the counties during the year 1899 was \$130,111.04.

ESTIMATES FOR 1900.

For the year 1900 the commission has recommended an appropriation of \$500,000, with the condition, as heretofore, that \$100,000 should be available only after Jan. 1, 1901. This sum is believed to be necessary and sufficient for the proper extension of the great system of State highways, of which already more than 250 miles have been constructed. Concerning them the report of a year ago may be quoted: "They are so distributed over the Commonwealth that nearly every community enjoys their advantages and has had an opportunity to judge of their quality. They have received unstinted praise from the best authorities in other parts of the country, and the State of Massachusetts is everywhere regarded as the leader in the important work of public road improvement, in which the whole country has been so much interested during the past few years."

The commission is of the opinion that the sum recommended can be expended with greater efficiency and economy than either a larger or smaller amount, and it also believes that an appropriation of this sum for each year, for at least two years in advance, would greatly facilitate all engineering and construction work, and materially reduce the cost of the same.

THE REPORT OF THE GEOLOGIST.

In June of the past year a short leave of absence was granted the geologist, who visited Europe at his own expense, making a somewhat exhaustive examination of roads and road building in various European countries, and preparing a report to the commission, embodying the results of this investigation. In Appendix B a brief resume of this report will be found, together with a general account of the methods of testing road materials employed in Europe and in this country, especially by the commission. There is also a somewhat extended discussion by the

geologist of the nature of materials most used in road building, with special reference to the principal causes which lead to a deterioration of road surfaces. This report contains much information of interest and value to road builders.

LEGISLATION.

The commission renews its recommendation of a year ago, that section 4 of chapter 497 of the Acts of 1894 be so amended as to reduce the time allowed municipal authorities in which to consider the taking of a contract from thirty days to ten days. Ten days is considered amply sufficient for such investigations as the authorities may wish to make before deciding the question; and, as the tendency is almost invariably to postpone action until the last moment, twenty days of the best part of the working season would be saved.

In the report of 1898 and in that of 1899 the commission recommended legislation looking to the assessment upon cities and towns in which State roads have been built of the cost of maintaining them. It is still of opinion that this would be a wise measure, and for the two reasons which were given in its support a year ago: first, there is real and considerable *local* benefit accruing to the town in which a State road is built, although under existing law it contributes toward construction and maintenance no more than any other town in the county of which it is a part; second, a local incentive to care for and properly treat a State highway will greatly diminish the annual cost of maintenance. All expenditures for maintenance, however, should continue to be under the direction of the State Highway Commission; otherwise, uniform and proper treatment of roads would be impossible.

Some embarrassment has arisen out of the apparent impossibility of giving up a location when once accepted by the commission. It often happens that changes in bounds, although of no great magnitude, would be extremely desirable, and occasionally actual errors in establishing bounds occur. The commission should have the power to give up or modify a location at such times and under such conditions as may seem to make such action necessary or desirable, either in the interests of the Commonwealth or in justice to abutters.

After several years' experience under existing statutes, the

commission believes that the time has come for important changes in its own organization, to the end that the now very extensive and very important responsibilities which rest upon it may be met in a more satisfactory manner than is possible at present. During the earlier years of its existence it was quite possible for commissioners who were expected to devote a relatively small portion of their time to the duties of their office to keep well in touch with practically all the work in the field and in the office. Every year, however, has added to the extent and complexity of this work; until now its magnitude is so great that it is impossible for the commissioners to have that thorough knowledge of all operations which is so desirable, even if they devote two or three times as many days per week to their duties as was originally contemplated or could fairly be expected. It is only fair to say that the commissioners have given, during the past two or three years, a much larger share of their time and energy to their official duties than could reasonably be demanded of them, but they have been forced to the conclusion that the best results will not be possible under the present form of organization. They propose, therefore, an amendment to the statute such as will modify the duties of the commissioners in accordance with the following general principles. They are of opinion that two of the commissioners should devote their entire time to the work of the commission. Were this possible, the best results would be reached by a tentative division of the State into two districts, over each of which a commissioner should exercise general jurisdiction, becoming in time familiar with every locality and detail of construction, supply of materials, etc., within that district. It should be arranged that on every day in the week at least one of the commissioners would be in the office in Boston. While all important questions would be determined by the commission as a whole, large powers could be delegated to each of the two commissioners referred to, so that not so much time of the commission, when in session as such, would be frittered away in the consideration of details more or less trivial in character.

To secure the proper and orderly working of such a system, a third commissioner is necessary, and he should be, by nomination or by the statute, the chairman of the Board. He must be well enough informed as to the general status of the work to

discuss and vote intelligently upon the larger and more important questions which will be brought before the commission as a whole. In virtue of his office, he may exercise special scrutiny over the financial operations of the commission, the organization and work of the office, and other matters not particularly technical in character. It is believed that he could do all of this, and thoroughly, too, without devoting as much time to his duties as is now required of every member of the commission, and his compensation may be adjusted accordingly.

In order to secure the end in view, it is recommended that section 1, chapter 476, Acts of 1893, be amended as follows: In place of the sentence "They shall each receive in full compensation," etc., insert the following: "One member of the commission, to be designated by the governor immediately after the passage of this act, shall be chairman of the commission; he shall receive in full compensation for his services an annual salary of one thousand dollars, payable in equal monthly instalments, and also his travelling expenses, including the actual necessary expenses of his attendance at the meetings of the commission. The other two members of the commission, who shall be highway engineers of experience and recognized high standing, shall each receive in full compensation for their services an annual salary of five thousand dollars, payable in equal monthly instalments, and also their travelling expenses, and they shall devote their entire time to the performance of their duties as State Highway Commissioners."

Such a change in the duties and organization of the commission as is here recommended can be brought about without any increase whatever in the cost of maintaining it; and as it will, in the opinion of the commissioners, very greatly increase the efficiency and economy of administration, the Legislature is respectfully urged to give it favorable consideration.

EXPENDITURES.

The following is a summary of the expenditures of the Highway Commission for the year 1899:—

CONSTRUCTION EXPENDITURES.

TOWN OR CITY.	Year of Lay-out.	Amount.	Totals.
<i>Barnstable County.</i>			
Barnstable,	1899	\$6,212 96	\$24,867 05
Bourne,	1898	2,538 70	
Chatham (1st),	1899	1,346 33	
Chatham (2d),	1899	2,060 31	
Harwich,	1899	3,498 35	
Sandwich,	1898	8,328 35	
Truro,	1895	382 05	
<i>Berkshire County.</i>			
Cheshire,	1899	\$1,604 60	22,199 74
Dalton,	1896	8 66	
Great Barrington,	1897	680 54	
Great Barrington,	1896	4,014 39	
Hancock,	1898	4 40	
Hancock,	1899	8,761 00	
Lenox,	1899	2,499 43	
Pittsfield,	1898	329 23	
Richmond,	1898	643 39	
Richmond,	1899	3,155 75	
Windsor,	1897	250 11	
Williamstown,	1898	248 24	
<i>Bristol County.</i>			
Dartmouth,	1899	\$9,583 62	22,639 83
North Attleborough,	1899	2,898 73	
Rehoboth,	1899	1,436 51	
Somerset,	1899	4,834 60	
Taunton,	1898	142 31	
Taunton,	1899	3,744 06	
<i>Dukes County.</i>			
Cottage City,	1896	\$248 71	931 62
Edgartown,	1897	165 07	
Edgartown,	1899	517 84	
<i>Essex County.</i>			
Andover,	1897	\$7 70	31,603 76
Andover,	1899	4,878 79	
Amesbury,	1899	77 36	
Gloucester,	1898	2,119 46	
Hamilton,	1899	3,573 37	
Haverhill,	1899	6,885 99	
Merrimac,	1898	3,459 73	
Merrimac,	1899	1,350 16	
Newburyport,	1898	2,229 31	
Newbury,	1899	1,442 60	
Swampscott,	1898	2,172 03	
Saugus,	1898	3,407 26	
<i>Amount carried forward, . . . . .</i>				$101,742 00

CONSTRUCTION EXPENDITURES — *Continued.*

TOWN OR CITY.	Year of Lay-out.	Amount.	Totals.
<i>Amount brought forward,</i>			\$101,742 00
<i>Franklin County.</i>			
Ashfield,	1897	\$306 48	
Ashfield (1st),	1898	1,653 73	
Ashfield (2d),	1898	2,572 88	
Ashfield (Bridge),	1898	1,150 00	
Ashfield,	1897-98	1,724 29	
Buckland,	1898	3,373 33	
Buckland,	1899	2,664 02	
Charlemont,	1898	667 75	
Charlemont (Bridge),	1898	7,078 43	
Charlemont,	1899	1,422 81	
Colrain,	1898	2,960 83	
Erving,	1898	5,419 14	
Erving,	1899	2,704 24	
Greenfield,	1899	7,818 20	
Montague,	1898	2 93	
Orange,	1899	326 22	
			41,845 28
<i>Hampden County.</i>			
Brimfield,	1899	\$9,108 16	
Chicopee,	1897	300 54	
Chicopee,	1898	4,343 18	
Chester,	1899	3,718 87	
Palmer,	1899	5,944 81	
Russell,	1897	103 17	
Russell (1st),	1898	158 71	
Russell (2d),	1898	3,889 34	
Russell,	1899	5,624 87	
Westfield (2d),	1898	63 93	
Westfield (1st),	1899	714 61	
Westfield (2d),	1899	6,450 64	
			40,420 83
<i>Hampshire County.</i>			
Hadley,	1898	\$274 28	
Hadley,	1899	486 75	
Northampton,	1898	2,917 71	
Northampton,	1899	3,899 23	
South Hadley,	1898	666 89	
South Hadley,	1899	4,508 16	
Williamsburg (1st),	1898	1,494 12	
Williamsburg (2d),	1898	5,011 90	
Ware,	1899	637 17	
			19,896 21
<i>Middlesex County.</i>			
Ashby,	1898	\$1,763 82	
Ashby,	1899	3,886 04	
Acton,	1899	5,168 58	
Boxborough,	1899	3,575 72	
<i>Amounts carried forward,</i>		\$13,894 16	\$203,904 32

CONSTRUCTION EXPENDITURES — *Continued.*

TOWN OR CITY.	Year of Lay-out.	Amount.	Totals.
<i>Amounts brought forward,</i>		\$13,894 16	\$203,904 32
Concord,	1898	7 59	
Chelmsford,	1898	9,652 50	
Lexington,	1898	167 55	
Marlborough,	1899	6,922 51	
North Reading,	1898	4,361 00	
Reading,	1899	3,946 85	
Sudbury,	1898	5,887 56	
Townsend,	1898	3,472 11	
Townsend (Bridge),	1899	1,925 74	
Weston,	1899	14,878 58	
Winchester,	1899	4,905 44	
			70,021 59
<i>Nantucket County.</i>			
Nantucket,	1899	\$2,239 45	2,239 45
<i>Norfolk County.</i>			
Cohasset,	1899	\$2,396 48	
Milton,	1899	141 78	
Norfolk,	1899	890 88	
Norwood,	1899	3,689 18	
Weymouth,	1896	80 73	
Weymouth,	1897	6 60	
Wrentham,	1898	1,802 63	
Wrentham,	1899	306 71	
Westwood,	1899	587 87	
Walpole,	1898	4,683 71	
			14,586 57
<i>Plymouth County.</i>			
Brockton,	1897	\$69 44	
Brockton,	1898	327 10	
Brockton,	1899	8,767 71	
Duxbury,	1899	3,985 06	
Marshfield,	1898	1,148 80	
Marshfield,	1899	3,088 85	
Marion,	1899	4,355 58	
Plymouth,	1896	1,841 15	
Plymouth,	1897	5,304 96	
			28,888 65
<i>Suffolk County.</i>			
Revere,	1897	\$2,870 21	
Revere,	1899	1,426 42	
			4,296 63
<i>Worcester County.</i>			
Auburn,	1898	\$1,927 36	
Auburn,	1899	8,323 23	
Brookfield,	1898	3,243 08	
Barre,	1899	6,076 50	
Blackstone,	1899	4,881 87	
<i>Amounts carried forward,</i>		\$24,452 04	\$323,937 21

CONSTRUCTION EXPENDITURES — *Concluded.*

TOWN OR CITY.	Year of Lay-out.	Amount.	Totals.
<i>Amounts brought forward,</i>		\$24,452 04	\$323,937 21
Gardner,	1898	1,488 08	
Gardner,	1897-98	7,892 80	
Grafton,	1899	4,660 00	
Leicester,	1898	1,819 76	
Leicester,	1899	42 50	
Lunenburg,	1898	434 20	
Lunenburg,	1899	5,260 96	
Northborough,	1898	4,521 90	
Phillipston,	1897	557 72	
Phillipston,	1898	642 46	
Paxton,	1898	33 57	
Sterling,	1898	859 69	
Sutton,	1899	4,057 28	
Shrewsbury,	1899	4,683 24	
Spencer,	1897	124 19	
Templeton,	1899	6,011 76	
Uxbridge,	1897	501 72	
Uxbridge,	1898	1,260 68	
Worcester,	1896	193 48	
Westminster,	1897	33 68	
Westminster,	1898	1,956 69	
Westminster,	1899	5,007 19	
West Boylston,	1897	436 36	
West Boylston,	1898	706 47	
Westborough,	1897	52 27	
Warren,	1898	639 33	
Warren,	1899	52 26	
West Brookfield (East),	1899	5,265 47	
West Brookfield (West),	1899	284 13	
			83,371 88
Total,			\$407,309 09

REPAIR AND MAINTENANCE EXPENDITURES.

TOWN OR CITY.	Amount.	Totals.
<i>Barnstable County.</i>		
Barnstable,	\$99 98	
Brewster,	206 76	
Bourne,	48 46	
Chatham,	6 62	
Dennis,	272 41	
<i>Amount carried forward,</i>	\$684 23	

REPAIR AND MAINTENANCE EXPENDITURES — *Continued.*

TOWN OR CITY.	Amount.	Totals.
<i>Amount brought forward,</i>	\$634 23	
Sandwich,	440 66	
Truro,	121 17	
Yarmouth (North),	262 85	
Yarmouth (South),	550 60	\$2,009 51
<i>Berkshire County.</i>		
Adams,	\$86 38	
Dalton,	343 44	
Great Barrington,	438 67	
Hancock,	519 15	
Lee,	692 08	
North Adams,	183 45	
Pittsfield,	406 11	
Richmond,	42 98	
Williamstown,	193 33	
Windsor,	14 70	2,920 29
<i>Bristol County.</i>		
Acushnet,	\$528 60	
Dartmouth,	197 10	
Fairhaven,	75 92	
North Attleborough,	35 65	
Rehoboth,	316 06	
Somerset,	238 83	
Taunton,	81 11	
Westport,	1,333 09	2,806 36
<i>Dukes County.</i>		
Cottage City,	\$630 39	
Edgartown,	93 96	
Tisbury,	215 60	
West Tisbury,	150 93	1,090 88
<i>Essex County.</i>		
Andover,	\$173 57	
Beverly,	261 08	
Gloucester,	348 11	
Lawrence,	14 40	
Methuen,	77 27	
Merrimac,	25 02	
Newburyport,	204 81	
Swampscott,	200 21	
Wenham,	70 74	
West Newbury,	443 94	1,819 15
<i>Franklin County.</i>		
Ashfield,	\$138 40	
Buckland,	198 13	
<i>Amounts carried forward,</i>	\$336 53	\$10,646 19

REPAIR AND MAINTENANCE EXPENDITURES — *Continued.*

TOWN OR CITY.	Amount.	Totals.
<i>Amounts brought forward,</i>	\$336 53	\$10,646 19
Charlemont,	58 80	
Colrain,	55 93	
Deerfield,	530 14	
Montague,	179 49	
Orange,	266 76	
Shelburne,	175 42	
Sunderland,	5 75	
		1,608 82
<i>Hampden County.</i>		
Brimfield,	\$25 63	
Chicopee,	204 45	
Monson,	159 76	
Russell,	371 65	
West Springfield,	95 01	
Wilbraham,	113 22	
Westfield,	336 09	
		1,305 81
<i>Hampshire County.</i>		
Easthampton,	\$151 53	
Goshen,	83 73	
Granby,	68 11	
Hadley,	258 60	
Huntington,	144 04	
Northampton,	14 56	
South Hadley,	320 01	
Williamsburg,	185 92	
Ware,	41 17	
		1,267 67
<i>Middlesex County.</i>		
Ashby,	\$1,292 15	
Bedford,	16 59	
Boxborough,	15 05	
Concord,	134 20	
Chelmsford,	17 21	
Lexington,	143 60	
Lincoln,	97 87	
Lowell (North),	179 18	
Lowell (South),	94 26	
Marlborough,	86 60	
North Reading,	59 36	
Stoneham,	57 00	
Sudbury,	28 11	
Tyngsborough,	369 29	
Townsend,	44 42	
Watertown,	270 11	
Wayland,	18 90	
Weston,	97 75	
		3,021 65
<i>Amount carried forward,</i>		\$17,850 14

REPAIR AND MAINTENANCE EXPENDITURES — *Continued.*

TOWN OR CITY.	Amount.	Totals.
<i>Amount brought forward,</i> . . . . .	. . . . .	\$17,850 14
<i>Norfolk County.</i>		
Cohasset,	\$77 65	
Holbrook,	120 49	
Norfolk,	160 02	
Norwood,	94 90	
Walpole,	322 94	
Wrentham,	284 47	
Weymouth,	198 11	
		1,258 58
<i>Nantucket County.</i>		
Nantucket,	\$635 71	
		635 71
<i>Plymouth County.</i>		
Brockton,	\$15 38	
Duxbury,	93 35	
Hingham,	130 50	
Marion,	121 81	
Marshfield,	80 80	
Mattapoisett,	99 62	
Middleborough,	126 88	
Plymouth,	635 90	
Scituate,	159 95	
Whitman,	51 75	
Wareham,	126 09	
		1,642 08
<i>Suffolk County.</i>		
Revere,	\$193 75	
		193 75
<i>Worcester County.</i>		
Athol,	\$289 80	
Auburn,	167 48	
Barre,	25 04	
Brookfield,	15 36	
Fitchburg,	183 58	
Grafton,	59 65	
Gardner,	229 38	
Holden,	120 82	
Hardwick-New Braintree,	67 16	
Lunenburg,	13 94	
Leicester,	493 24	
Northborough,	38 64	
Paxton,	192 73	
Phillipston,	109 40	
Princeton,	15 87	
Shrewsbury,	280 65	
Sturbridge,	11 85	
Sterling,	34 07	
Templeton,	3 85	
<i>Amounts carried forward,</i>	\$2,352 51	\$21,580 21

REPAIR AND MAINTENANCE EXPENDITURES — *Concluded.*

TOWN OR CITY.	Amount.	Totals.
<i>Amounts brought forward,</i>	\$2,352 51	\$21,580 21
Uxbridge,	47 46	
Westminster,	105 15	
Worcester,	128 37	
Warren,	232 85	
Westborough,	42 94	
West Boylston,	48 75	
		2,958 03
Total,		\$24,538 24

GENERAL OFFICE EXPENSES.

[Under Acts of 1899, chapter 367.]

Salaries of commissioners,	\$6,000 00	
Travel of commissioners,	1,053 91	
Clerical assistants, and chief, first and second assistant engineers,	16,420 55	
Printing, including postal cards and stamped envelopes,	1,104 08	
Advertising hearings,	112 43	
Office supplies,	239 63	
Telephone, including tolls,	212 17	
Postage,	182 94	
Examining titles,	81 55	
Recording land takings,	150 98	
Analysis of paint,	45 00	
Freight and cartage on paint,	65 24	
Miscellaneous items, including telegraph and express charges, car fares and minor office expenses,	295 88	
		\$25,964 36

ROAD MACHINERY.

[Under Acts of 1899, chapter 396.]

Five steam rollers,	\$9,925 00
-------------------------------	------------

RELOCATION OF STREET RAILWAYS.

[Under Acts of 1896, chapter 541.]

Worcester, 1898 section,	\$11,277 18
Total expenditure for the year,	\$479,013 87

STATEMENT OF CLAIMS AGAINST THE COMMISSION.

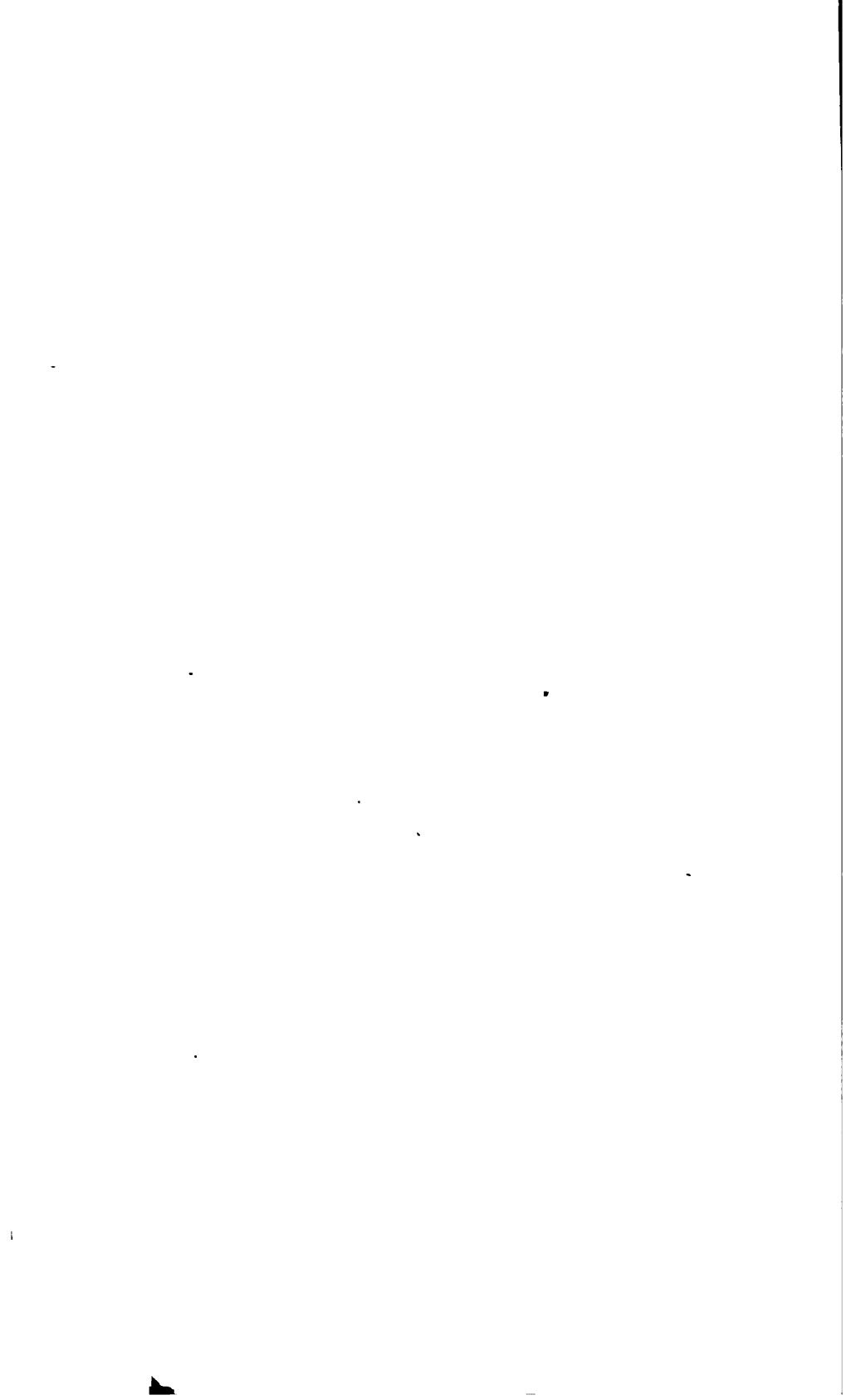
[As required by chapter 366, Acts of 1898.]

NAME.	Residence.	Nature of Claim.	Amount.	Remarks.
Booth, E.,	Whitman,	Damages owing to change of grade,	\$135 70	Amount awarded by jury.
Gookin, J. S.,	Revere,	Damages caused by construction of State road in Revere,	10 77*	Award not yet accepted.
Gould, O. E.,	Leicester,	Damages caused by taking of land and change of grade,	800 00	Suit entered.
Graves, E. S., and Brown, C. A.,	Marblehead,	Damages caused by construction of State road in Swampscott,	602 28*	Suit entered.
Haviland, J. B.,	Ludlow,	Bill for services in making surveys,	948 74	Suit entered.
Moseley, S. E.,	Revere,	Damages caused by construction of State road in Revere,	38 68*	Award not yet accepted.
Parker, C. H.,	Revere,	Damages caused by construction of State road in Revere,	4 16*	Award not yet accepted.
Smith, H. O.,	Leicester,	Damages caused by construction of State road in Leicester,	-	Suit entered.
Wadsworth, C.,	Walpole,	Damages caused by construction of State road in Walpole,	-	Suit entered.
Wilkins, M. A.,	Swampscott,	Damages caused by construction of State road in Swampscott,	5 00*	Award not yet accepted.
Wynnan, Isaac C.,	Swampscott,	Damages caused by construction of State road in Swampscott,	44 50*	Suit entered.

* Amount awarded by commission.

T. C. MENDENHALL,
W. E. MCCLINTOCK,
CHARLES W. ROSS,

Massachusetts Highway Commission.



APPENDIX.

APPENDIX A.

REPORT OF CHIEF ENGINEER.

BOSTON, MASS., Dec. 31, 1899.

To the Massachusetts Highway Commission.

GENTLEMEN :— I submit the following report on work done during the year 1898.

All the work laid out in the year 1897 is completed. All the work laid out in 1898 is completed, except the construction of Washington Street, Quincy. This was delayed at the request of the city authorities, owing to a petition of the Quincy & Boston Street Railway Company for a double-track location.

All the work laid out early in 1899 is completed, except the roads in Norwood, Revere and Saugus ; and many of the roads for which allotments were made from the 1899 appropriation are also finished. Most of the remaining roads could have been completed, if the contractors had foreseen the favorable fall and early winter.

Most of the work during the past year has consisted in reconstructing existing roads, the most important being the Salem Turnpike. The exceptions are the Hancock, Brimfield and Marlborough roads, where the locations were changed to obtain easier grades ; and the new highway in Haverhill, following the Lowell, Lawrence & Haverhill Street Railway along the north bank of the Merrimac River.

STATEMENT OF EXPENDITURES FOR 1899.

The Legislature of 1898 appropriated \$100,000 for State road construction in 1899, which enabled the commission to make allotments early in the year. The Legislature of 1899 appropriated \$500,000, of which \$400,000 was for work in 1899, but was not available until June. If the appropriations were available by April 1 of each year, a study of the roads in

their worst condition could be made, all the allotments could be expended, and the number of employees could be reduced.

Construction work during the past year has been carried on under 116 contracts, covering 127 lay-outs, made in 9 cities and 79 towns.

The following statement exhibits the construction work done in the year 1899 :—

Excavation and borrow (cubic yards),	193,465.61	
Ledge excavation (cubic yards),	5,114.73	
Culverts built (approximate number),	315	
Bridges built,	2	
Dry masonry (cubic yards),	3,350.63	
Cement masonry (cubic yards),	2,981.38	
Gravel (cubic yards, including 6,183.84 yards screened),	26,916.89	
Telford (tons),	3.31	
Shaping (square yards),	355,656.05	
Macadam and gravel surfacing (square yards),	476,323.76	
Broken stone (tons),	106,288.48	
Guard rail (lineal feet),	35,348.20	
Side drains (lineal feet),	41,746.10	
Side drain outlets (lineal feet),	1,472.30	
Vitrified clay pipe (lineal feet),	{ smaller than 12-inch,	2,578.40
	{ 12-inch,	5,024.85
	{ 15-inch,	444.20
	{ 18-inch,	794.00
	{ 20-inch,	193.60
Iron pipe (lineal feet),	{ 24-inch,	590.90
	{ 10-inch,	90.50
	{ 12-inch,	946.50
	{ 14-inch,	41.50
	{ 16-inch,	34.70
	{ 18-inch,	145.20
	{ 20-inch,	36.00
{ 24-inch,	120.00	
{ 30-inch,	60.00	
Stone bounds set,	1,192	
Catch-basins (number),	99	

WORK OF SURVEYING DEPARTMENT.

Surveys have been made in 52 towns, a total length of 84.11 miles. This work has consisted of the location of all the walls, fences, ditches, bounds, etc., which indicate boundaries of the road or divisions of the abutting property; also all houses within 100 feet of the line of location, and all cross-streets for a dis-

tance of 200 feet from the line of location, as well as a complete set of cross-sections of the road taken at 50-foot intervals, with sufficient additional sections to show the amount of earth-work that will be necessary in grading the road.

Plans, profiles and cross-sections have been plotted for 66 miles of road, and estimates prepared for the same. For the construction work, 64.04 miles of road have been staked and grades given.

In addition to the regular work of the commission, surveys, plans, profiles, cross-sections, estimates and specifications have been made for 3.39 miles of road for the use of towns which contemplate and are building macadam roads in conjunction with the State work.

Final surveys have been made and final estimates prepared for 80 contracts. Record plans have been made for all work completed in 1898.

BRIDGES.

During the past year a bridge has been built in Brockton, of I-beam construction, brick arches and solid floor. A bridge in Chester has been widened, the construction being of I-beams and wooden floor.

On the Salem Turnpike it will probably be necessary to rebuild the bridge over the Pines River, between Revere and Saugus, a bridge over a creek in Revere and also a bridge over a creek in Saugus.

MAINTENANCE.

No serious damage has been caused by floods or freshets. The amount expended in maintenance has been caused for the most part by the cleaning of gutters and shoulders, and the placing of binding material upon roads travelled mostly by light vehicles and upon roads where the binder is removed by the wind faster than the wear of the stone supplies it.

A large amount of broken stone has been purchased and stacked for repairs.

During the past year most of the guard rail on all the State roads has been repainted.

The tendency to travel in a single track is gradually lessening on the oldest roads. The South Hadley and Granby roads are the only instances where apparently but little attention is paid to the "Don't drive in the middle of the road" signs.

The people driving over the roads in other sections of the State appear willing to assist in maintaining the roads to the extent of driving out of one line.

An examination of the width of travelled way shows that the average width of road used is but 9 feet, which seems to show that the width of macadam usually built by the commission, 15 feet, is ample except in the vicinity of the larger towns. Macadam 12 feet wide is sufficient for the lighter travelled roads, but 10 feet is too narrow unless good gravel can be obtained for the shoulders.

The standard thickness of macadam, 6 inches after rolling, appears to be ample for the heaviest travel, provided the sub-soil is sand or gravel and well drained. Where the drainage is poor, the thickness of macadam should be increased or side drains should be laid.

On clayey soils good sandy gravel has been used in place of telford, with good results. At Leicester, as gravel for the 1898 lay-out would have to be hauled a long distance, and as stone, although of poor quality, was abundant and would cost no more than gravel, 6 inches of broken stone as it came from the crusher was used for a foundation. The result has been perfectly satisfactory.

GRAVEL ROADS.

The roads in Brimfield, Colrain and West Boylston, built of screened gravel, have given satisfaction, but show the wearing effects of travel; and, as the saving in expense of this construction over the cost of a macadam road will not equal the cost of maintenance compared with the maintenance of a macadam road, the screened gravel roads do not seem to be economical.

Where the commission has built gravel roads, it has generally been at the request of the local authorities. Although when these roads are first built they give satisfaction, later, when the wear is evident, the local parties regret that they did not ask for macadam at first.

Gravel can be of no better quality for road purposes than the ledge stone in the same vicinity. Where the stone is soft, gravel obtained in the vicinity does not wear well. Gravel suitable for road surfacing is not uniformly distributed throughout the State, and in many sections is not to be found.

LOCAL STONE.

Roads which are surfaced with native stone other than trap rock consolidate under the roller much quicker than when trap rock is used. As such roads wear sufficiently fast to supply binding material, and as the stone does not unravel, these roads at first give the most satisfaction; but they wear rapidly, and, unless the stone is uniformly soft, the harder stone in time is left above the softer, and a hizzly surface results, making re-surfacing necessary.

TRAP ROCK.

Where trap rock is used for surfacing, it requires two or three times more rolling to consolidate than native stone. Frequently after a road surfaced with trap rock is opened to travel, unless a large excess of screenings is used in its construction, or the road is watered daily for a few weeks after completion, the stone becomes loose, and re-rolling and watering are necessary. Where this is the case, the road is sometimes condemned by the public as being poorly built, compared with roads in the vicinity built of local stone. But after the surface becomes compacted by the travel, as it does sooner or later, depending upon the volume and character of the travel, the trap-rock road improves, while the road built of native stone other than trap deteriorates. The use of trap rock, therefore, is recommended in all cases where its cost is not excessive.

MEASUREMENT OF MATERIAL.

When material is paid for by the load, it never gives satisfaction to both parties, and this practice should not be adopted. Estimating quantities from cart measurements is inaccurate, owing to the difference in capacity of the carts used, and because cart loads may not be uniform. For this reason, material should either be measured in the pit, previously cross-sectioned, or measured in place, with an agreed percentage for shrinkage.

The following statement shows the difference in the capacity of eight double teams and three single teams which were used on one of the State roads:—

Capacity of Double Teams.

	Cu. Ft.
Team No. 1,	48.24
Team No. 2,	53.67
Team No. 3,	36.00
Team No. 4,	43.27
Team No. 5,	42.77
Team No. 6,	43.21
Team No. 7,	46.85
Team No. 8,	42.00
Total,	<u>356.01</u>

Capacity of Single Teams.

	Cu. Ft.
Team No. 1,	22.90
Team No. 2,	28.38
Team No. 3,	22.90
Total,	<u>74.18</u>

The average capacity of the double teams was 44.50 cubic feet, or 1.648 cubic yards; the average capacity of the single teams was 24.72 cubic feet, or 0.915 cubic yard. The measurements of the double and the single teams included the sideboards. The material moved was sandy gravel and hard-pan.

CART MEASUREMENTS.

Quantity of Material moved by Double Teams.

Total number of loads,	2,234
Number of cubic yards,	3,681.630
Cubic yards per load,	1.648
Percentage of material moved, . . . . .	.852

Quantity of Material moved by Single Teams.

Total number of loads,	702
Number of cubic yards,	642.330
Cubic yards per load, . . . . .	.915
Percentage of material moved, . . . . .	.148

MEASUREMENTS FROM CROSS-SECTIONS.

Quantity of Material moved by Double Teams.

Number of cubic yards,	3,136.212
Cubic yards per load,	1.404

Quantity of Material moved by Single Teams.

Number of cubic yards,	544.788
Cubic yards per load, . . . . .	.776

Total number of cubic yards moved by double
and single teams, 3,681

As the actual measurement of a double cart load was 1.648 cubic yards, and the load hauled was 1.404 cubic yards, according to the pit measurements, the shrinkage of the double loads was 14.8 per cent.

The actual measurement of a single cart load was 0.915 cubic yard, and, as the load hauled was 0.776 cubic yard, the shrinkage was 15.1 per cent.

The carts were loaded to the top of the side-boards, and the material was heaped in the centre at least four inches. The shrinkage shown is the difference between the actual cubical contents of the carts and the quantity determined from the cross-sections of the pit.

AN EXPERIMENT WITH OIL.

The section of State road in Cottage City, near Sengekon-tacket Pond, is peculiarly exposed to sweeping winds, which remove the binding material and make it difficult to maintain the road in satisfactory condition. For this reason it was thought to be a good road on which to experiment with oil, the supposition being that the oil would prevent the removal of the binding material by the wind; accordingly, 12 50-gallon barrels of "road-bed" oil were purchased from the Standard Oil Company, the cost being \$2.25 per barrel.

The oil was used on a section of road 1,800 feet long. For a length of 800 feet the width of road treated was 15 feet, the oil being put on at the rate of about 50 gallons to 100 lineal feet of road. On the remainder of the oil-treated section the oil was applied 8 feet in width. The entire cost, including transportation, labor, etc., was \$4.35 per 100 lineal feet of road, using 50 gallons of oil per 100 lineal feet, applied for a width of 15 feet.

The oil was applied in June, and was at first thought to be a great success, as no dust blew from the section treated with oil,

while on the rest of the road it blew in clouds. The good effect, however, was not lasting, for a month later the stone began to unravel, and it was necessary to spread binding material. There was also some complaint that on the oil-treated section of road the material thrown into carriages by the wheels injured robes and clothing.

In the first of the accompanying tables, in which the figures are given in feet, are shown the maximum width of the travelled way and the width commonly used for travel on the different roads. In the second table are shown the highways constructed or contracted for by the commission, and the nature of the several constructions, to Jan. 1, 1900.

Respectfully submitted,

CHAS. MILLS,

Chief Engineer.

TABLE SHOWING WIDTHS OF TRAVELLED WAY.

TOWN OR CITY.	County.	Width of Macadam.	MAXIMUM WIDTH OF TRAVELLED WAY.				WIDTH OF COMMONLY TRAVELLED WAY.			
			1896.	1897.	1898.	1899.	1896.	1897.	1898.	1899.
Acton, . .	Middlesex, .	15	-	-	-	18	-	-	-	10
Acushnet, .	Bristol, .	15	-	15	18	12-15	-	12	9	7-9
Adams, . .	Berkshire, .	15	-	-	11	11	-	-	7	7
Amesbury, .	Essex, . .	15	-	-	-	-	-	-	-	-
Andover (N.), ¹	Essex, . .	18	24	24	24	26	24	20	16	20
Andover (S.), ²	Essex, . .	15	-	-	11	13	-	-	8	10
Ashby, . .	Middlesex, .	15-18-20	12	12	12	14	9	9	9	10
Ashfield, . .	Franklin, .	Gravel,	-	-	16	12	-	-	10	9
Athol, . .	Worcester, .	17	16	16	20	18	10-12	12	14	14
Auburn, . .	Worcester, .	15-18	12	13	14	15	9	9	10	10
Barnstable (N.), ³	Barnstable, .	15	-	-	-	10	-	-	-	7
Barnstable (S.), ³	Barnstable, .	15-18	-	-	21	18-21	-	-	12	15
Barre, . .	Worcester, .	15	-	13	14	14	-	9	7	8
Blackstone, .	Worcester, .	15	-	-	-	11	-	-	-	8.5
Bedford, . .	Middlesex, .	15	-	12	15	15	-	8	10	9
Beverly, . .	Essex, . .	18	20-24	22	24	20-25	20	16	15	14-20
Bourne, . .	Barnstable, .	15	-	10	18	12-15	-	8	9	9
Boxborough, .	Middlesex, .	15	-	12	13	14	-	8	10	10
Brewster, . .	Barnstable, .	15	-	12	12	12	-	9	9	9
Brimfield, . .	Hampden, .	Gravel,	-	-	11	15	-	-	8	11
Brockton, . .	Plymouth, .	16	-	18	12	18-21	-	12	9	12
Brookfield, .	Worcester, .	15	-	12	12	12.5-16	-	9	9	8.5-11
Buckland, . .	Franklin, .	4-	10	10	15	15	7-9	8	8	8-9
Charlemont, .	Franklin, .	15-21	-	15	15	15	-	10	10	10
Chelmsford, .	Middlesex, .	18	-	-	-	16	-	-	-	12
Cheshire, . .	Berkshire, .	Gravel,	-	-	-	-	-	-	-	-
Chester, . .	Hampden, .	15	-	-	-	12	-	-	-	10
Chicopee, . .	Hampden, .	20	-	20	20	20	-	12	12	18
Cohasset, . .	Norfolk, .	15	-	-	10	12	-	-	7	7
Chatham, . .	Barnstable, .	12-15	-	-	-	12	-	-	-	9
Colrain, . .	Franklin, .	Gravel,	-	-	-	14	-	-	-	8
Concord, . .	Middlesex, .	15	-	15	15	16	-	10	10	11
Cottage City, .	Dukes, . .	15	-	21	10	13	-	15	7	9
Dalton, . .	Berkshire, .	15	20	20	21	16-21	20	16	18	12-18
Dartmouth, . .	Bristol, . .	18	-	-	-	15-18	-	-	-	12

¹ 1894 and 1896 lay-outs. ² 1897 lay-out. ³ 1899 lay-out. ⁴ Widths of macadam, 12, 15, 18, 24

TABLE SHOWING WIDTHS OF TRAVELLED WAY—*Continued.*

TOWN OR CITY.	County.	Width of Macadam.	MAXIMUM WIDTH OF TRAVELLED WAY.				WIDTH OF COMMONLY TRAVELLED WAY.			
			1896.	1897.	1898.	1899.	1896.	1897.	1898.	1899.
Deerfield, . .	Franklin, .	15	12-14	14	16	16	11	12	12	12
Dennis, . .	Barnstable, .	15	-	12	15	12-15	-	9	7	9
Duxbury, . .	Plymouth, .	15	12-14	12	10	12	7	9	7	7
Easthampton, .	Hampshire, .	15	12-13	12	14	15	9-10	10	10	10
Edgartown, .	Dukes, .	15	-	21	10	12	-	15	7	8
Erving, . .	Franklin, .	Gravel,	-	-	-	10	-	-	-	7
Fairhaven, . .	Bristol, .	15	-	18	18	15-18	-	12	10	12
Fitchburg (E.), .	Worcester, .	15-18	-	-	18	18	-	-	15	16
Fitchburg (W.), .	Worcester, .	15	15	14	18	18	10	10	15	14
Gardner, . .	Worcester, .	15	-	12	15	14	-	8	10	9
Gloucester, . .	Essex, .	15	15	17	18	18	15	13	12	12
Goshen, . .	Hampshire, .	15	10	11	10	12	7	8	7	8
Grafton, . .	Worcester, .	15	-	11	14	15	-	9	10	12.5
Granby, . .	Hampshire, .	15	9	14	14	13	5	10	8	8
Gt. Barrington, .	Berkshire, .	15-18	-	25	25	15-20	-	12	14	12-15
Gt. Barrington, .	Berkshire, .	Gravel,	-	-	25	15	-	-	11	12
Greenfield, . .	Franklin, .	18	-	-	-	18	-	-	-	10
Hadley, . .	Hampshire, .	15	15-18	14-17	18	18	10	10	10	10
Hancock, ¹ . .	Berkshire, .	Gravel,	-	18	11	12	-	8	9	8
Hancock, ² . .	Berkshire, .	Gravel,	-	-	-	12	-	-	-	10
Hamilton, . .	Essex, .	15	-	-	-	14	-	-	-	10
Hardwick, . .	Worcester, .	15	-	-	15	15	-	-	8	8
Harwich, . .	Barnstable, .	15	-	-	-	10	-	-	-	7
Haverhill, . .	Essex, .	Graded,	-	-	-	-	-	-	-	-
Hingham (W.), ³ .	Plymouth, .	Gravel,	17	15	15	12-18	10	9	10	9
Hingham (E.), ⁴ .	Plymouth, .	15	-	10	10	10-12	-	8	7	7-9
Holbrook, . .	Norfolk, .	15	-	12	9	12	-	8	7	9
Holden, . .	Worcester, .	15-18	13-18	11	14	15	10	9	10	12
Huntington, . .	Hampshire, .	15	9	11	11	12	7	8	9	8
Lawrence, . .	Essex, .	18	-	21	21	25	-	17	16	18
Lee, . .	Berkshire, .	15-24	15-21	17	19	14-20	12-15	11	13	10-14
Leicester, . .	Worcester, .	15-18-24	15	20	25	18-21	10-12	12	15	13-18
Lenox, . .	Berkshire, .	15	-	-	-	-	-	-	-	-
Lexington, . .	Middlesex, .	15	15-20	16	15	15	15	12	10	11
Lincoln, . .	Middlesex, .	15	15	15	15	15	10	9	10	10

¹ 1895 and 1896 lay-outs. ² 1898 lay-out. ³ 1894 lay-out. ⁴ 1896 and 1897 lay-outs.

TABLE SHOWING WIDTHS OF TRAVELLED WAY — *Continued.*

TOWN OR CITY.	County.	Width of Macadam.	MAXIMUM WIDTH OF TRAVELLED WAY.				WIDTH OF COMMONLY TRAVELLED WAY.			
			1896.	1897.	1898.	1899.	1896.	1897.	1898.	1899.
Lowell (N.),	Middlesex,	18	-	15-25	25	25	-	9-12	10	10-15
Lowell (S.),	Middlesex,	18	-	18	20	22	-	12	12	16
Lunenburg,	Worcester,	16	-	-	-	15	-	-	-	12
Marion (E.), ¹	Plymouth,	16	15	18	15	12-15	10	9	10	9
Marion (W.), ²	Plymouth,	16	-	12	15	12-15	-	9	10	9
Marlborough (E.),	Middlesex,	15	-	-	12	14	-	-	10	10
Marlborough (W.),	Middlesex,	15	-	-	14	14	-	-	10	11
Marshfield,	Plymouth,	16	14	12	11	12	8	9	7	7
Mattapoisett,	Plymouth,	16	-	18	16	15-18	-	12	10	12
Merrimac,	Essex,	16	-	12	12	13	-	9	9	10
Methuen,	Essex,	16	-	15	16	18	-	10	12	13
Middleborough,	Plymouth,	16	25-30	12-21	21	12-24	20-25	9-21	10	9-15
Milton,	Norfolk,	24	-	-	-	-	-	-	-	-
Monson,	Hampden,	16	12	14	15	19	8-10	10	10	14
Montague,	Franklin,	15	-	-	9	9	-	-	7	7
Nantucket,	Nantucket,	12-15	-	21	16	12-15	-	8	7	7-9
New Braintree,	Worcester,	15	-	-	15	15	-	-	8	8
Newbury,	Essex,	15	-	-	-	-	-	-	-	-
Newburyport,	Essex,	15	15	13	13	14	8-10	9	10	11
Norfolk,	Norfolk,	15	10	10	9	9-12	10	7	7	7-9
North Adams,	Berkshire,	15	10-12	13	14	15-20	8-10	9	10	12
Northampton (Bridge Street),	Hampshire,	20	18	18	18	18	12	14	12	14
Northampton,	Hampshire,	15	-	12	18	16	-	10	12	12
No. Attleborough,	Bristol,	15-24	15-20	18	21	12-21	10-15	15	12	9-15
No. Attleborough,	Bristol,	Gravel,	-	6	8	9-12	-	6	6	7-9
Northborough,	Worcester,	16	-	12	14	14	-	8	10	11
North Reading,	Middlesex,	15	-	-	11	12	-	-	8	10
Norwood (N.),	Norfolk,	15	-	16	16	15-18	-	10	10	10
Norwood (S.),	Norfolk,	15	-	-	12	12	-	-	9	9
Orange,	Franklin,	17	16	16	20	20	10-12	12	15	15
Palmer,	Hampden,	15	-	-	-	14	-	-	-	10
Paxton,	Worcester,	15	13	13	13	15	9	10	10	12
Phillipston,	Worcester,	15	-	-	12	12	-	-	10	10
Pittsfield (W.),	Berkshire,	15	-	21	14	15	-	12	11	12
Pittsfield (E.),	Berkshire,	Gravel,	-	-	25	21	-	-	18	18

¹ 1894 and 1895 lay-outs.² 1897 lay-out.

TABLE SHOWING WIDTHS OF TRAVELLED WAY — *Continued.*

TOWN OR CITY.	County.	Width of Macadam.	MAXIMUM WIDTH OF TRAVELLED WAY.				WIDTH OF COMMONLY TRAVELLED WAY.			
			1866.	1867.	1868.	1869.	1866.	1867.	1868.	1869.
Plymouth, . .	Plymouth, .	15	15	12	9	10-15	9	8	7	7-9
Princeton, . .	Worcester, .	15	-	11	12	15	-	8	9	10
Quincy, . . .	Norfolk, . .	-	-	-	-	-	-	-	-	-
Reading, . . .	Middlesex, .	15	-	-	-	14	-	-	-	11
Rahoboth, . .	Bristol, . . .	15	9	15	12	12	9	9	7	9
Revere (Beachmont),	Suffolk, . . .	24	-	-	23	24	-	-	15	12-22
Revere, ¹ . . .	Suffolk, . . .	22	-	-	-	-	-	-	-	-
Richmond, . .	Berkshire, .	Gravel,	-	16	9	10	-	8	7	7
Russell (Fairfield),	Hampden, . .	15	8-10	11	12	12	7	7	10	8-10
Russell (Huntington),	Hampden, . .	15	8-10	11	12	12	7	7	10	8-10
Sandwich, . .	Barnstable, .	15	-	11	9	9-12	-	9	7	7
Saugus, . . .	Essex, . . .	22	-	-	-	-	-	-	-	-
Scituate, . . .	Plymouth, .	15	14	18	18	16-18	8	12	10	12
Shelburne, . .	Franklin, . .	15-18	12-15	12-15	20	20	8	10	12	12
Shrewsbury, .	Worcester, .	15-18	12-18	18	20	20	7-12	12	14	15
Somerset, . .	Bristol, . . .	15-18	15	18	18	18-21	9	12	9	10-15
South Hadley, .	Hampshire, .	15	15	14	14	14	10	10	10	8
Spencer, . . .	Worcester, .	15	-	-	-	-	-	-	-	-
Sterling, . . .	Worcester, .	15	-	11	12	12	-	7	7	8
Stoneham, . .	Middlesex, .	15	-	-	15	18	-	-	10	12
Sturbridge, . .	Worcester, .	15	-	11	14	15	-	8	12	12
Sudbury, . . .	Middlesex, .	15	-	-	12	14	-	-	10	10
Sunderland, .	Franklin, . .	15	-	-	16	16	-	-	12	12
Sutton, . . .	Worcester, .	15	-	-	-	18	-	-	-	9
Swampscott, .	Essex, . . .	Gravel,	-	-	-	25	-	-	-	15
Taunton, . . .	Bristol, . . .	15	20	20	15	18-19	10-15	10	8	7-12
Templeton, . .	Worcester, .	15	-	-	-	14	-	-	-	8
Tisbury, . . .	Dukes, . . .	15	-	21	15	15-18	-	15	10	12
Townsend, . .	Middlesex, .	15	-	12	13	14	-	8	8	8
Truro, . . .	Barnstable, .	10-15	-	6	6	9	-	6	6	5-7
Tyngsborough, .	Middlesex, .	15	10	12	12	13	10	8	9	9
Uxbridge, . . .	Worcester, .	15	-	-	12	13	-	-	8	10.5
Walpole (Norwood),	Norfolk, . .	15	15	12	12	12	8	9	9	9
Walpole (Norfolk),	Norfolk, . .	15	-	10	10	10-12	-	7	7	7-9
Ware, . . .	Hampshire, .	15	-	-	15	15	-	-	8	8

¹ Salem Turnpike.

TABLE SHOWING WIDTHS OF TRAVELLED WAY — *Concluded.*

TOWN OR CITY.	County.	Width of Macadam.	MAXIMUM WIDTH OF TRAVELLED WAY.				WIDTH OF COMMONLY TRAVELLED WAY.			
			1896.	1897.	1898.	1899.	1896.	1897.	1898.	1899.
Wareham (E.), .	Plymouth, .	15	-	15	12	12-15	-	10	7	9
Wareham (W.), .	Plymouth, .	15	-	-	12	12	-	-	7	8
Warren, . . .	Worcester, .	15	13	12	12	15	7	9	9	12
Watertown, . .	Middlesex, .	27	33	33	33	33	25-30	25-30	25	25
Wayland, . . .	Middlesex, .	15	-	-	13	14	-	-	9	11
Wenham, . . .	Essex, . . .	15-18	-	14	14	14	-	9	11	11
Westborough, .	Worcester, .	15	-	12	12	13	-	10	9	10
West Boylston, .	Worcester, .	15	-	-	12	15	-	-	9	11
West Brookfield (E.), .	Worcester, .	15	-	-	-	14	-	-	-	8.5
West Brookfield (W.), .	Worcester, .	15	-	-	-	-	-	-	-	-
Westminster, .	Worcester, .	15	15	15	15	15	9	10	14	14
West Newbury, .	Essex, . . .	15	14	12	14	14	8	8	9	10
Weston, . . .	Middlesex, .	18	-	-	25	20	-	-	20	15
Westfield (E.), .	Hampden, . .	15-18	13	13	16	15-18	9	9	12	12-14
Westfield (W.), .	Hampden, . .	15-18	-	-	14	14	-	-	11	11
Westport, . . .	Bristol, . . .	18	14	21	21	15-18	14	12	12	9-12
W. Springfield, .	Hampden, . .	18	12-15	14	18	18	10	10	15	15
West Tisbury, .	Dukes, . . .	10-12-15	-	15-20	15	15-18	-	8-15	7	12
Westwood, . . .	Norfolk, . .	15	-	-	-	-	-	-	-	-
Weymouth, . . .	Norfolk, . .	15	21	18-21	17	18-21	21	12-15	10	12-15
Whately, . . .	Franklin, . .	12	-	-	-	-	-	-	-	-
Whitman, . . .	Plymouth, . .	18	15	22	21	21	11	13	12	15
Wilbraham, . .	Hampden, . .	15	8-9	11	11	12	7	8	8	9.5
Williamsburg, .	Hampshire, .	15	-	12	12	12	-	8	8	8
Williamstown, ¹ .	Berkshire, . .	15	10-12	13	13	15	9	9	10	12
Williamstown, ² .	Berkshire, . .	15	-	-	13	17	-	-	9	14
Winchester, . .	Middlesex, . .	20	-	-	-	18	-	-	-	13
Windsor, . . .	Berkshire, . .	Gravel,	-	12	9	10	-	6	6	7
Worcester (Paxton), .	Worcester, . .	15	-	12	20	14	-	10	10	10
Worcester (Holden)	Worcester, . .	15	-	-	14	14	-	-	10	10
Wrentham (N.), .	Norfolk, . . .	15	-	11	10	9-12	-	8	7	7-9
Wrentham (S.), .	Norfolk, . . .	15	-	11	18	12-18	-	8	7	9-12
Yarmouth (N.), .	Barnstable, . .	15	-	15-21	21	12-21	-	12-15	9	9-12
Yarmouth (S.), .	Barnstable, . .	15	-	12-21	21	12-21	-	8-15	7	9-12

¹ 1895 and 1896 lay-outs.² 1898 lay-out.

TABLE SHOWING THE HIGHWAYS CONSTRUCTED OR CONTRACTED FOR BY THE COMMISSION, AND THE NATURE OF THE SEVERAL CONSTRUCTIONS, TO JAN. 1, 1900.

[In the last column, the capital letters used have the following significance: A, trap; B, local field stone; C, local ledge other than trap; D, bottom course local field stone, top course trap; E, limestone; F, gravel; G, gravel and thin macadam; H, screened gravel; K, clay and thin macadam; M, clay and screened gravel.]

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Acton,	1899,	Concord line,
2	Acushnet,	1897,	1,500 feet east from New Bedford line,
3	Adams,	1897,	Cheshire line,
4	Amesbury,	1899,	Merrimac line,
5	Andover,	1895-96,	Lawrence line,
6	Andover,	1897,	North Reading line,
7	Andover,	1899,	End of 1897 lay-out,
8	Ashby,	1894-98,	Ashby post-office,
9	Ashby,	1899,	End of 1898 lay-out,
10	Ashfield,	1897-98,	One mile north of Ashfield post-office,
11	Athol,	1895-96,	Orange line,
12	Auburn,	1895-97,	Dunn's Mills,
13	Auburn,	1898,	Worcester line,
14	Auburn,	1899,	End of 1898 lay-out,
15	Barnstable (North),	1899,	Sandwich line,
16	Barnstable (South),	1897,	Yarmouth line,
17	Barre,	1897,	Bridge over Ware River,
18	Barre,	1899,	End of 1897 lay-out,
19	Bedford,	1897,	Lexington line,
20	Beverly,	1895-97-98,	Wenham line,
21	Blackstone,	1899,	Uxbridge line,
22	Bourne,	1897-98,	Cohasset Narrows,
23	Boxborough,	1897,	Acton line,
24	Boxborough,	1899,	End of 1897 lay-out,
25	Brewster,	1895-97,	Dennis line,
26	Brimfield,	1897,	Monson line,
27	Brimfield,	1899,	About 200 feet south of 1897 lay-out, .
28	Brockton,	1897-98,	West Street,
29	Brockton,	1899,	End of 1898 lay-out,
30	Brookfield,	1897-98,	Mill Street,
31	Buckland,	1894-98,	Shelburne Falls station,
32	Buckland,	1899,	End of 1898 lay-out,

TABLE SHOWING THE HIGHWAYS CONSTRUCTED OR CONTRACTED FOR BY THE COMMISSION, AND THE NATURE OF THE SEVERAL CONSTRUCTIONS, TO JAN. 1, 1900.

[In the last column, the capital letters used have the following significance: A, trap; B, local field stone; C, local ledge other than trap; D, bottom course local field stone, top course trap; E, limestone; F, gravel; G, gravel and thin macadam; H, screened gravel; K, clay and thin macadam; M, clay and screened gravel.]

ROAD LAID OUT.		Length Constructed	WIDTHS.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
Northerly, . .	2.10	.72	50+	15	3	A.	1
Northerly, . .	.63	.63	50+	15	3	B.	2
Northerly, . .	.57	.57	50	15	3	A.	3
Easterly, . .	.51	Partly graded	50-60	15	3	B.	4
Southerly, . .	1.22	1.22	66	18	3	D.	5
Northerly, . .	.48	.48	60	15	3	C.	6
Northerly, . .	.69	.69	66	15	3	C.	7
Southerly, . .	3.14	3.14	66-50	20-18-15	3	B.	8
South-westerly, .	.44	.44	50	15	3-5	B.	9
Northerly, . .	1.61	1.61	50-70	-	-	H.	10
Easterly, . .	1.61	1.61	50	17	3	D-A.	11
Southerly, . .	1.93	1.93	50	15	3	'95 A, '96-7 B.	12
Southerly, . .	.45	.45	50	18	3	A.	13
South-westerly, .	.69	.69	50+	15	-	A.	14
South-easterly, .	.95	.95	50	15	-	B.	15
Westerly, . .	.85	.85	40+	18-15	3	B.	16
North-westerly, .	.67	.67	49-5	15	3	A.	17
North-westerly, .	.60	.60	49-5	15	-	A.	18
North-westerly, .	.55	.55	50	15	3	B.	19
Southerly, . .	2.06	2.06	50-60	18	3	'95-7 A, '98 C.	20
South-easterly, .	.64	.64	50+	15	3	A-G.	21
Easterly, . .	1.42	1.42	45+	15	3	B-C.	22
Westerly, . .	.68	.76	50	15	3	B.	23
Westerly, . .	.68	.60	60	15	4	B.	24
Easterly, . .	2.48	2.48	40-50	15	3	B.	25
Southerly, . .	1.17	1.17	50	-	-	H.	26
South-easterly, .	1.17	1.17	60	Graded.	-	F.	27
Westerly, . .	1.18	1.18	33	16	8.5	B.	28
Westerly, . .	.68	.68	33	16	8.5	B.	29
Easterly, . .	.88	.88	50	15	3	A.	30
North-westerly, .	2.52	2.52	30-50	24-18-15-12	3	A-O.	31
Westerly, . .	.36	.36	50	12	3	A.	32

TABLE SHOWING THE HIGHWAYS CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Charlemont,	1897-98, . . .	Bridge over Deerfield River,
2	Charlemont,	1899,	End of 1898 lay-out,
3	Chatham,	1899,	Depot Street,
4	Chelmsford,	1898,	Lowell line,
5	Chelmsford,	1899,	End of 1898 lay-out,
6	Cheshire,	1899,	Farnham station, Boston & Albany Railroad.
7	Chester,	1899,	100 feet from Becket line,
8	Chicopee,	1897-98, . . .	Springfield line,
9	Chicopee,	1899,	End of 1898 lay-out,
10	Cohasset,	1897,	Near Hingham line,
11	Cohasset,	1899,	End of 1897 lay-out,
12	Colrain,	1898,	Shelburne line,
13	Concord,	1897-98, . . .	Lincoln line,
14	Cottage City,	1894-96, . . .	Sengekontacket bridge,
15	Dalton,	1895-96, . . .	Pittsfield line,
16	Dartmouth,	1898,	Westport line,
17	Dartmouth,	1899,	End of 1898 lay-out,
18	Deerfield,	1894-95, . . .	South Deerfield station,
19	Dennis,	1895-98, . . .	Yarmouth line,
20	Duxbury,	1894-95-97, . . .	Marshfield line,
21	Duxbury,	1899,	End of 1897 lay-out,
22	Easthampton,	1895-96, . . .	Northampton line,
23	Edgartown,	1897,	Sengekontacket bridge,
24	Edgartown,	1899,	End of 1897 lay-out,
25	Erving,	1898,	Town Hall,
26	Erving,	1899,	End of 1898 lay-out,
27	Fairhaven,	1894-95, . . .	Mattapoissett line,
28	Fitchburg,	1894-95, . . .	Westminster line,
29	Fitchburg,	1897,	Lunenburg line,
30	Gardner,	1897-98, . . .	Templeton line,
31	Gloucester,	1894-96-98, . . .	Manchester line,
32	Goshen,	1894-95, . . .	Goshen village,
33	Grafton,	1897,	Millbury line,
34	Grafton,	1899,	End of 1897 lay-out,

CONTRACTED FOR BY THE COMMISSION, ETC. — *Continued.*

ROAD LAID OUT.		Length Con- structed.	WIDTHS.			Material of Road Surface.	
Direction.	Length		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
Easterly, . .	.64	.64	42+	15	3	D.	1
South-easterly, .	.13	.13	50	15	-	D.	2
North-westerly, .	.59	.59	50	15-12	-	A.	3
Westerly, . .	.82	.82	50	18	3	A.	4
Westerly, . .	.11	.11	50	18	3	A.	5
North-easterly, .	.95	-	50	Partly graded.	-	G-A.	6
North-easterly, .	.34	.34	50	15	3	A.	7
Northerly, . .	.87	.87	50-60	20	4-3	A.	8
Northerly, . .	.06	.06	55	-	-	A.	9
Easterly, . .	.42	.47	50	15	3	D.	10
Easterly, . .	.49	.44	50+	15	-	D.	11
Northerly, . .	1.08	1.08	40-50	-	-	H.	12
North-westerly, .	1.47	1.47	50	15	3	B.	13
Northerly, . .	2.37	2.37	50	15	3	B.	14
Easterly, . .	1.56	1.56	30-60	15	7.5	A.	15
Easterly, . .	.56	.56	80	-	-	B.	16
Easterly, . .	.74	.74	80+	18	-	B.	17
South-easterly, .	1.53	1.53	30	15	3	A.	18
North-easterly, .	4.26	4.26	40-50-65	15	3	B.	19
Southerly, . .	1.41	1.41	30-40	15	3	B-C.	20
Southerly, . .	.69	.69	40-50	15	3	A.	21
South-westerly, .	1.32	1.32	40	15	3	A.	22
Southerly, . .	.32	.32	50+	15	3	B.	23
South-easterly, .	.29	.11	50	15	3	B.	24
Easterly, . .	.80	.80	50+	-	-	F.	25
Easterly, . .	.42	.42	50	Gravel.	-	F.	26
Westerly, . .	1.45	1.45	30	15	3	B.	27
Easterly, . .	.97	.97	50	15	3	A.	28
Westerly, . .	.61	.61	50	18-15	3	D.	29
Easterly, . .	2.37	2.37	50+	15	-	G.	30
North-easterly, .	2.48	2.48	50	15	3	C-B.	31
South-easterly, .	1.91	1.91	50	15	3	B.	32
Easterly, . .	.79	.79	50	15	3	B.	33
South-easterly, .	.53	.48	50+	15	3	G-A.	34

TABLE SHOWING THE HIGHWAYS CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Granby,	1894,	South Hadley line,
2	Great Barrington,	1894-95-97,	Housatonic River,
3	Greenfield,	1899,	225 feet north-west of Boston & Maine bridge, near Deerfield line.
4	Hadley,	1894-95,	Connecticut River bridge,
5	Hadley,	1899,	End of 1895 lay-out,
6	Hamilton,	1899,	2 miles north from Wenham line,
7	Hancock,	1895-96-98,	Pittsfield line,
8	Hancock,	1899,	End of 1895 lay-out,
9	Hardwick,	1897,	New Braintree line,
10	Harwich,	1899,	Base River bridge,
11	Haverhill,	1899,	West end of River Street,
12	Hingham,	1894,	Weymouth Back River,
13	Hingham,	1895-97,	Near Cohasset line,
14	Holbrook,	1894-95,	Weymouth line,
15	Holden,	1894-97,	{ 1894-95, Holden village, 1897 end of 1894 lay-out,
16	Holden,	1895,	Worcester line,
17	Huntington,	1895-96,	Russell line,
18	Lawrence,	1895,	Methuen line,
19	Lee,	1894-95,	Lee Park,
20	Leicester,	1894-95-96-98,	Worcester line,
21	Leicester,	1899,	End of 1895 lay-out,
22	Lenox,	1899,	Half-way between Lenoxdale and Lee line.
23	Lexington,	1895-96,	Massachusetts Avenue,
24	Lincoln,	1895-97,	Concord line,
25	Lowell (Boulevard),	1897,	Tyngsborough line,
26	Lowell (Princeton Street),	1897-98,	Chelmsford line,
27	Lunenburg,	1898,	Fitchburg line,
28	Lunenburg,	1899,	End of 1895 lay-out,
29	Lynn,	1899,	264 feet north of centre of channel of Saugus River and Revere line.
30	Marion,	1894-95,	Marion village,
31	Marion,	1897,	Marion village,
32	Marion,	1899,	End of 1897 lay-out,
33	Marlborough (East),	1897,	Sudbury line,
34	Marlborough (West),	1897,	Northborough line,

CONTRACTED FOR BY THE COMMISSION, ETC.— *Continued.*

ROAD LAID OUT.		Length Con- structed.	WIDTHS.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
North-easterly, .	.63	.63	36	15	3	A.	1
Easterly, . . .	2.79	2.79	40-50-70	18-15	3	A.	2
North-westerly, .	.59	.59	49.5-50	18	-	A.	3
Easterly, . . .	2.24	2.24	50-82.5-66+	15	3	A.	4
Easterly, . . .	.49	Partly graded.	50	15	3	A.	5
North-easterly, .	.66	.66	50	15	3	B.	6
Westerly, . . .	2.24	2.24	50	-	-	F.	7
Westerly, . . .	.98	Partly graded.	50+	Gravel.	-	-	8
Northerly, . . .	.89	.89	50	15	3	A.	9
Easterly, . . .	.89	.66	40+	15	-	A.	10
Westerly, . . .	2.08	Partly graded.	70	-	-	-	11
Easterly, . . .	1.42	1.42	34	-	-	F.	12
Westerly, . . .	1.23	1.23	50-33+	15	3	D.	13
Westerly, . . .	1.11	1.11	50	15	3	B-C.	14
Northerly, } Southerly, }	2.70	2.70	30-49.5+	18-15	3	B.	15
Northerly, . . .	.46	.46	50	15	3-5	B.	16
Westerly, . . .	1.01	1.01	50+	15	3	A.	17
Southerly, . . .	.27	.27	50	18	7	C.	18
Easterly, . . .	1.98	1.98	40-35-50	24-15	3	D.	19
Westerly, . . .	4.19	4.19	39-53-55-67+	24-18-16-15	3-5-5.5	'94-6D, '98B.	20
North-westerly, .	.63	-	50-55	15	3	-	21
Southerly, . . .	.89	Partly graded.	56±	15	3	D.	22
Westerly, . . .	3.45	3.45	50-50+	15	3	B.	23
South-easterly, .	2.06	2.06	50	15	3	B.	24
Easterly, . . .	.97	.97	60	15	3	D.	25
Easterly, . . .	1.34	1.34	50±	18	6	D.	26
Easterly, . . .	.43	.43	50	15	3	D.	27
North-easterly, .	.61	.61	50	15	-	D.	28
North-easterly, .	.90	-	70	-	-	-	29
North-easterly, .	1.43	1.43	40	15	3	B.	30
Westerly, . . .	.57	.57	55	15	3	B.	31
Southerly, . . .	.81	.81	40	15	-	B.	32
Westerly, . . .	.40	.40	50-60	15	3	B.	33
Easterly, . . .	.73	.73	50	15	5-4-3	B.	34

TABLE SHOWING THE HIGHWAYS CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Granby,	1894,	South Hadley line,
2	Great Barrington,	1894-96-97,	Housatonic River,
3	Greenfield,	1890,	225 feet north-west of Boston & Maine bridge, near Deerfield line.
4	Hadley,	1894-96,	Connecticut River bridge,
5	Hadley,	1890,	End of 1898 lay-out,
6	Hamilton,	1890,	2 miles north from Wenham line,
7	Hancock,	1895-96-98,	Pittsfield line,
8	Hancock,	1899,	End of 1898 lay-out,
9	Hardwick,	1897,	New Braintree line,
10	Harwich,	1899,	Bass River bridge,
11	Haverhill,	1899,	West end of River Street,
12	Hingham,	1894,	Weymouth Back River,
13	Hingham,	1896-97,	Near Cohasset line,
14	Holbrook,	1894-96,	Weymouth line,
15	Holden,	1894-97,	{ 1894-96, Holden village, 1897 end of 1894 lay-out,
16	Holden,	1898,	Worcester line,
17	Huntington,	1895-96,	Russell line,
18	Lawrence,	1896,	Methuen line,
19	Lee,	1894-96,	Lee Park,
20	Leicester,	1894-95-96-98,	Worcester line,
21	Leicester,	1899,	End of 1898 lay-out,
22	Lenox,	1899,	Half-way between Lenoxdale and Lee line.
23	Lexington,	1895-98,	Massachusetts Avenue,
24	Lincoln,	1895-97,	Concord line,
25	Lowell (Boulevard),	1897,	Tyngsborough line,
26	Lowell (Princeton Street),	1897-98,	Chelmsford line
27	Lunenburg,	1898,	Fitchburg line
28	Lunenburg,	1899,	End of
29	Lynn,	1899,	264
30	Marion,		
31	Marion,		
32	Marion,		
33	Marlborough (East),		
34	Marlborough (West),		

CONFIDENTIAL COPY OF THE [REDACTED] ACT. - [REDACTED]

State Cash Rec.		State Cash Exp.		State Cash Bal.		State Cash Total	
Month	Year	Month	Year	Month	Year	Month	Year
January	1915	January	1915	January	1915	January	1915
February	1915	February	1915	February	1915	February	1915
March	1915	March	1915	March	1915	March	1915
April	1915	April	1915	April	1915	April	1915
May	1915	May	1915	May	1915	May	1915
June	1915	June	1915	June	1915	June	1915
July	1915	July	1915	July	1915	July	1915
August	1915	August	1915	August	1915	August	1915
September	1915	September	1915	September	1915	September	1915
October	1915	October	1915	October	1915	October	1915
November	1915	November	1915	November	1915	November	1915
December	1915	December	1915	December	1915	December	1915

TABLE SHOWING THE HIGHWAYS CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Marlborough,	1899,	End of 1897 lay-out,
2	Marshfield,	1894-96-98, . .	Duxbury line,
3	Marshfield,	1899,	End of 1898 lay-out,
4	Mattapolsett,	1894-95,	Fairhaven line,
5	Merrimac,	1897-98,	Near Haverhill line,
6	Merrimac,	1899,	End of 1898 lay-out,
7	Methuen,	1896,	Lawrence line,
8	Middleborough,	1894-98,	Nemasket River,
9	Milton,	1899,	Neponset River,
10	Monson,	1894,	Railroad bridge,
11	Montague,	1898,	Junction pipe line with ferry road, east,
12	Montague,	1899,	End of 1898 lay-out,
13	Nantucket,	1894-96,	First mile-stone, ¹
14	Nantucket,	1896-97,	Easterly end of 1895 lay-out,
15	Nantucket,	1899,	End of 1897 lay-out,
16	New Braintree,	1897,	Hardwick line,
17	Newbury,	1899,	Newburyport line,
18	Newburyport,	1896-98,	West Newbury line,
19	Norfolk,	1896,	Walpole line,
20	North Adams,	1894-96-97, . .	Williamstown line,
21	Northampton,	1894,	Hadley bridge,
22	Northampton,	1897,	Easthampton line,
23	Northampton,	1898,	City Street (bridge),
24	Northampton,	1899,	End of 1898 lay-out,
25	Northampton,	1899,	End of 1897 lay-out,
26	North Attleborough,	1894-97,	Bruce Avenue,
27	North Attleborough,	1899,	End of 1897 lay-out,
28	Northborough (East),	1897-98,	Marlborough line,
29	Northborough (South),	1897,	Westborough line,
30	North Reading,	1897-98,	Andover line,
31	Norwood,	1896-96,	Ellis station,
32	Norwood,	1897,	Walpole line,
33	Norwood,	1899,	End of 1897 lay-out,
34	Orange,	1894-96-97, . .	Athol line,
35	Palmer,	1899,	Tenneyville, near Boston & Albany freight station.

¹ 1896, No. 2, from near seventh mile-stone, westerly.

CONTRACTED FOR BY THE COMMISSION, ETC.— *Continued.*

ROAD LAID OUT.		Length Con- structed.	WIDTHS.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
Easterly, . .	.64	Partly graded.	50	15	-	B.	1
Northerly, . .	1.46	1.46	30-40	15	3	B-C.	2
Northerly, . .	.55	.55	40-45	15	-	B-C.	3
Easterly, . .	1.16	1.16	30	15	3	B.	4
North-easterly, .	.86	.86	50+	15	4-3	B.	5
Easterly, . .	.06	.06	50	15	3	C.	6
North-easterly, .	1.04	1.04	50	15	3	C.	7
Southerly, . .	2.76	2.76	30-50	15	7.5-3	B.	8
South-easterly, .	.49	Partly graded.	49.5-82.5	-	-	A.	9
Northerly, . .	.93	.93	36	15	3	A.	10
North-westerly, .	1.09	1.09	60	15	3	A.	11
North-westerly, .	.54	-	60	-	-	-	12
Easterly, . .	3.23	3.23	66	15	3	B-E-G.	13
Easterly, . .	1.00	1.00	66	12	3	B-G.	14
Easterly, . .	.25	.25	66	12	3	B G.	15
Southerly, . .	.17	.17	50	15	3	A.	16
Southerly, . .	.52	Partly graded.	66-96	15	3	B.	17
Easterly, . .	1.75	1.75	60 60+-75+	15	3	C.	18
South-westerly, .	1.45	1.45	50	15	3	B.	19
Easterly, . .	1.69	1.69	30-66	15	3	D.	20
South-westerly, .	.56	.56	40	20	3	C.	21
Northerly, . .	.33	.33	50	15	3	A.	22
Southerly, . .	.27	.27	50	15	3	A.	23
Southerly, . .	.20	.20	50	15	-	A.	24
Northerly, . .	.16	Partly graded.	50	-	-	A.	25
South-westerly, .	3.21	3.21	36-66	24-18-15	3	'94-5B, '96-7F.	26
South-westerly, .	.38	.38	66	-	-	F.	27
South-westerly, .	1.36	1.36	66	15	4-3	B.	28
North-westerly, .	.42	.42	50	15	3	B.	29
Southerly, . .	1.01	1.01	66	15	3	C.	30
Southerly, . .	1.02	1.02	40-50-67	15	3	B.	31
Northerly, . .	.54	.57	50	15	3	B.	32
North-easterly, .	.50	.47	45-50-60	15	3	B.	33
Westerly, . .	2.18	2.18	30-49.5	17	3-5	D-A.	34
South-easterly, .	.68	.74	50	15	3	G-A.	35

TABLE SHOWING THE HIGHWAYS CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From—
1	Paxton,	1895-96, . . .	Worcester line,
2	Phillipston,	1897-98, . . .	Near Athol line,
3	Pittsfield,	1894-96, . . .	Hancock line,
4	Pittsfield,	1897,	Dalton line,
5	Plymouth,	1894-96, . . .	Beaver Dam Brook,
6	Princeton,	1897,	Princeton station,
7	Quincy,	1899,	Near Weymouth Fore River bridge,
8	Reading,	1899,	Stoneham line,
9	Rehoboth,	1895-96, . . .	Seekonk line,
10	Rehoboth,	1899,	End of 1896 lay-out,
11	Revere,	1897-98, . . .	Boston line,
12	Revere,	1899,	3,500 feet south west from Saugus line,
13	Richmond,	1897-98, . . .	Boston & Albany Railroad station,
14	Richmond,	1899,	End of 1898 lay-out,
15	Russell (Fairfield),	1894-96-97-98, . . .	Westfield line,
16	Russell (Huntington),	1894-95-96, . . .	Huntington line,
17	Russell,	1899,	End of 1898 lay-out, Fairfield,
18	Sandwich,	1897-98, . . .	Barnstable line,
19	Saugus,	1899,	Fox Hill bridge,
20	Scituate,	1894-96, . . .	North Scituate station,
21	Shelburne,	1894-97, . . .	Bridge Street,
22	Shrewsbury,	1895-96, . . .	Worcester line,
23	Shrewsbury,	1899,	End of 1898 lay-out,
24	Somerset,	1895-97, . . .	South Street,
25	Somerset,	1899,	End of 1897 lay-out,
26	South Hadley,	1895-97-98, . . .	Granby line,
27	South Hadley,	1899,	End of 1898 lay-out,
28	Spencer,	1897,	Leicester line,
29	Sterling,	1897-98, . . .	Near Town Hall,
30	Stoneham,	1897-98, . . .	South Street,
31	Sturbridge,	1897,	Fisk Hill Road,
32	Sudbury,	1897-98, . . .	Marlborough line,
33	Sunderland,	1897,	Connecticut River bridge,
34	Sutton,	1899,	Millbury line,
35	Swampscott,	1897,	Boston & Maine Railroad (Marblehead branch).

CONTRACTED FOR BY THE COMMISSION, ETC.—*Continued.*

ROAD LAID OUT.		Length Con- structed.	WIDTHS.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
North-westerly,	3.24	3.24	50-70	15	3-5	B.	1
Easterly, . .	1.19	1.19	50	15-12	4-3	B.	2
Easterly, . .	1.54	1.54	60-50-40	15	3	A.	3
Westerly, . .	.76	.76	50	-	-	A.	4
Southerly and northerly. ¹	3.86	3.86	40-50-112	15	3	B.	5
Easterly, . .	.49	.49	50	15	3	B.	6
North-westerly,	.49	-	63-66	-	-	-	7
Northerly, . .	.85	.73	66	15	3	B.	8
Easterly, . .	1.55	1.55	60	15	3	B.	9
Easterly, . .	.84	.28	60	15	-	B.	10
North-easterly, .	.58	.58	44-50	24	3	A.	11
North-easterly, .	.67	Partly graded.	71	22	2	A.	12
Northerly, . .	1.03	1.03	66	-	-	F.	13
North-easterly, .	.33	.33	66	Gravel.	-	-	14
Westerly, . .	4.03	4.03	50	15	3	'94 A, '96-'97- '93 F.	15
South-easterly, .	1.25	1.25	50	15	3	'94-'95 A, '98 F.	16
North-westerly, .	1.33	1.33	50	Gravel.	-	-	17
North westerly, .	1.33	1.33	50	15	3	B.	18
Southerly, . .	1.60	.33	71+	22	2	A.	19
South-easterly, .	1.17	1.17	30	15	3	B-C.	20
North-easterly, .	2.16	2.16	30-50	13-15	3	B-A.	21
North-easterly, .	3.01	2.95	50-65	13-15	5-4-3	B.	22
Easterly, . .	.44	.50	66	15	-	B.	23
Southerly, . .	2.05	2.05	40-60	13-15	3	B.	24
South-easterly, .	.70	.70	60	13	-	B.	25
South-westerly, .	1.49	1.49	36-50	15	3	A.	26
Westerly, . .	.67	.67	50	15	3	A.	27
Westerly, . .	.43	-	50	15	4-3	B.	28
South-westerly, .	1.29	1.29	50	15	3	A.	29
Northerly, . .	.57	.57	60-66	15	7.5	B.	30
Northerly, . .	.53	.53	50	15	4-3	B.	31
Easterly, . .	.96	.96	50-60	15	3	B.	32
Easterly, . .	.19	.19	50	15	3	A.	33
Southerly, . .	.49	.49	50	15	-	B.	34
North-easterly, .	1.03	1.03	60	-	-	F.	35

¹ 1895 and 1897 lay-outs northerly.

TABLE SHOWING THE HIGHWAYS CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Taunton,	1885-86-88,	Near Highland Street,
2	Taunton,	1889,	End of 1886 lay-out,
3	Templeton,	1889,	Gardner line,
4	Tisbury,	1894,	Vineyard Haven village,
5	Townsend,	1894-95,	Near Townsend Harbor,
6	Townsend,	1899,	End of 1896 lay-out,
7	Truro,	1895,	Wellfleet line,
8	Tyngsborough,	1895-96,	Tyngsborough bridge,
9	Uxbridge,	1897-98,	Blackstone line,
10	Walpole (South),	1894-95-97,	Norfolk line,
11	Walpole (North),	1897-98,	Norwood line,
12	Ware,	1897,	New Braintree line,
13	Ware,	1899,	End of town macadam,
14	Wareham,	1898,	Near Weweeantit bridge,
15	Wareham,	1898,	Cohasset Narrows bridge,
16	Warren,	1894-95,	West Warren,
17	Warren,	1899,	Village,
18	Watertown,	1895-96,	Waltham line,
19	Wayland,	1897,	Weston line,
20	Wenham,	1897,	Beverly line,
21	Westborough,	1897,	Near insane hospital,
22	West Boylston,	1897-98,	Worcester line,
23	West Brookfield (East),	1899,	Brookfield line,
24	West Brookfield (West),	1899,	Ware line,
25	Westfield,	1894-95-96,	West Springfield line,
26	Westfield,	1898,	End of town macadam,
27	Westfield,	1899,	End of 1898 lay-out,
28	Westminster,	1894-95,	Fitchburg line,
29	Westminster,	1899,	End of 1898 lay-out,
30	West Newbury,	1895-97,	Newburyport line,
31	Weston,	1898,	Near Waltham line,
32	Weston,	1899,	End of 1898 lay-out,
33	Westport,	1894-95 97-98,	East of railroad crossing,
34	West Springfield,	1895-96,	Top of Tatham hill,
35	West Tisbury,	1895-97,	Tisbury line,

CONTRACTED FOR BY THE COMMISSION, ETC. — *Continued.*

ROAD LAID OUT.		Length Con- structed.	WIDTHS.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet. 40-66	Feet. 15	Feet. 3		
Westerly, . .	1.80	1.80				B.	1
Westerly, . .	.84	.84	66	15	-	B.	2
North-westerly, .	.62	.62	60+	15	-	G-A.	3
South-westerly, .	1.93	1.93	50	15	3	B.	4
North-westerly, .	1.78	1.78	55-80	15	3	B.	5
North-westerly, .	.07	.07	55	15	-	B.	6
Northerly, . .	2.35	1.23	40	¹ 10-15	-	K-M.	7
South-easterly, .	2.95	2.95	60	15	3	A-D.	8
North-westerly, .	1.27	1.27	50	15	2-5	B.	9
Northerly, . .	1.97	1.97	50	15	3	C-B.	10
Southerly, . .	1.70	1.70	50	15	3	B.	11
Southerly, . .	.84	.84	50	15	3	A.	12
South-westerly, .	.84	Partly graded.	50	15	3	A.	13
Easterly, . .	.57	.57	50	15	3	B.	14
Westerly, . .	1.05	1.05	40+	15	3	B.	15
Easterly, . .	1.89	1.89	49.5-50	15	2-4	A.	16
Easterly, . .	.57	-	49.5	15	3	G-A.	17
Easterly, . .	.85	.85	36	27	2-4	A-B.	18
Westerly, . .	.61	.61	50	15	3	B.	19
Northerly, . .	.60	.60	50	15-18	4-12	A.	20
North-westerly, .	.71	.71	50	15	3	B.	21
Northerly, . .	1.55	1.55	50	15	3	'97 H, '98 A-H.	22
North-westerly, .	.43	.43	50	-	-	A.	23
South-westerly, .	.15	Partly graded.	50	15	3	A.	24
Westerly, . .	1.84	1.84	50	18-15	3	A.	25
Westerly, . .	.51	.51	50+	18	3	A.	26
North-westerly, .	1.12	1.12	50+	18-15	-	A.	27
South-westerly, .	2.70	2.70	50-80	15	3	D.	28
Westerly, . .	.30	.30	50	15	3	C.	29
Westerly, . .	2.22	2.22	50-110	15	2-4.5	D.	30
Westerly, . .	1.26	1.26	50	-	-	C.	31
Westerly, . .	1.89	1.89	50+	18	-	B.	32
Easterly, . .	4.25	4.25	66-80	18	3	C-B.	33
Easterly, . .	1.53	1.53	50-136	18	3	A.	34
South-westerly, .	2.84	2.84	50	15-12-10	3	B.	35

¹ Beach stone, 15 feet; broken stone and clay, 10 feet.

TABLE SHOWING THE HIGHWAYS CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Westwood,	1899,	Near Ellis station,
2	Weymouth,	1894,	Holbrook line,
3	Weymouth,	1895-97,	Fore River to Back River,
4	Whately,	1899,	Deerfield line,
5	Whitman,	1894-96,	Brockton line,
6	Willbraham,	1895-97,	New Springfield line,
7	Williamsburg,	1896-98,	Goshen line,
8	Williamstown,	1895-96-98,	North Adams line,
9	Winchester,	1899,	Arlington line,
10	Windsor,	1897,	Cummington line,
11	Worcester,	1896-97,	Paxton line,
12	Worcester,	1897,	Holden line,
13	Wrentham,	1894-96,	Near Berry Street,
14	Wrentham,	1897-98,	Norfolk line,
15	Wrentham,	1899,	End of 1894 lay-out,
16	Yarmouth (North),	1894-96,	Base River to Barnstable line,
17	Yarmouth (South),	1895-97,	Barnstable line to Dennis line,

CONTRACTED FOR BY THE COMMISSION, ETC. — *Concluded.*

ROAD LAID OUT.		Length Con- structed.	WIDTHS.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
Northerly, . .	.81	Partly graded.	46-60	15	3	B.	1
Easterly, . .	.25	.25	50	15	3	B.	2
Westerly, . .	1.75	1.75	125-50	15-18	3	A-B-C.	3
South-westerly, .	.78	-	50	12	3	A.	4
Easterly, . .	1.70	1.70	45	18	4	B.	5
Easterly, . .	1.91	1.91	50-79	15	3	A.	6
South-easterly, .	1.72	1.55	50	'98 graded, 15	3	B.	7
Westerly, . .	1.92	1.92	50-60-70	15	3	D.	8
North-easterly, .	.75	.75	50	20	-	C.	9
Westerly, . .	.28	.28	50	-	-	F.	10
South-easterly, .	1.35	1.35	50	15	3	B.	11
Southerly, . .	.66	.66	50	15	3	B.	12
South-easterly, .	1.62	1.62	26-34	15	3	B.	13
South-easterly, .	1.42	1.42	50	15	3	B.	14
Northerly, . .	.56	Partly graded.	50	15	-	B.	15
Westerly, . .	3.71	3.71	40-60	15	3	B.	16
Easterly, . .	5.10	5.10	40	15	3	B-C.	17

APPENDIX B.

REPORT OF GEOLOGIST.

To the Massachusetts Highway Commission.

GENTLEMEN:—I have the honor to submit herewith the annual report for the current year, and also a final report giving a general statement of the work of this laboratory since its establishment. A brief summary only of the work of the past year is given in the annual report, but results in detail are recorded in the Appendix. The final report includes among other things a short consideration of a few of the requirements in building and maintaining crushed-stone roads, inserted to show the practical relation of the laboratory tests to the choosing of materials; a discussion in some detail of the agencies of destruction, and an account of the laboratory tests, together with a statement of their relation to the actual conditions obtaining on roads. Incidentally many points concerning road materials other than stone are discussed for the sake of their bearing upon the main question under investigation.

It is to be regretted that the time has been insufficient to carry out thoroughly many of the plans undertaken at the laboratory, and the writer sincerely hopes that others will take up the work, where it is most regretfully left.

Respectfully submitted,

LOGAN WALLER PAGE,

Geologist.

ANNUAL REPORT OF GEOLOGIST.

During the past year the work at the laboratory has followed practically the same course as in previous years. Specimens of rock have been received, all of which have been submitted to the abrasion test, and as many as would permit to the cementation test.

Besides the routine work alluded to, a method has been established for determining the power of absorption of rock, and all the important samples of rock received at the laboratory since its establishment have been tested for this. The process is described in the accompanying Appendix.

The specific density has been determined for all specimens at the laboratory, from which has been calculated the weight of a cubic foot of stone, which is given in place of the specific density, as being of more practical value to road builders. The results of all tests have been tabulated in the accompanying Appendix.

Other plans, which will be spoken of further, were abandoned in consequence of the writer receiving leave of absence from the commission from the middle of June until the first of September, to go abroad for the purpose of studying road materials and road construction and maintenance. England, Scotland, Holland, Belgium and France were visited, of which a few observations are given below. The principal data collected will constitute a special report to the commission. In England the roads are made for the most part of broken stone, and are very largely of the Telford type. The stone is broken mainly by hand with pauper labor, which is plentiful and cheap, and hand-broken stone is in many cases preferred to that broken by machinery, it being generally believed to be more angular, and consequently to compact better under the roller. The stone is rarely screened, and much of it is broken in place. Steam rollers are very extensively used. The work is under the supervision of a road surveyor, appointed by the vestrymen of the parish in which the work is carried on, this being the case even in the city of London. But little study is given to road-building problems, and such experimental laboratory work as is done is carried on wholly by the private enterprise of individuals.

As an illustration of British methods, it is perhaps well to give the data collected respectively in one of the smaller and one of the larger towns. In Oxford, comparatively a small town, all the stone roads are of the Telford type. The method of construction is as follows. Six inches of hammer-broken limestone is placed by hand on a foundation previously rolled with a fifteen-ton steam roller. The limestone is well rolled in its turn; a three-inch layer of the same stone, broken to pass through a two-inch ring and mixed with a little gravel, is then laid down, and this layer is also rolled. A three-inch layer of quartzite is next added and rolled; a thin layer of quartzite, mixed with gravel and watered while being rolled, is placed on top. Unbroken limestone costs 3*s.* and 6*d.* (about 87 cents), and unbroken quartzite 7*s.* and 8*d.* (about \$1.91) per ton¹ on the road. Labor costs from 18 to 20 shillings (\$4.50 to \$5.00) per week, a working day being twelve hours. The entire cost of the complete road is about 3*s.* (75 cents) a square yard. Streets designed for heavy traffic are made in a similar way, except the top dressing is made of basalt, which costs 13*s.* to 14*s.* (\$3.25 to \$3.50) per ton on the road.

In London, as previously stated, all the work is done under parish supervision. All over the city stone is giving place to wood-block pavements, but some parishes still contain crushed-stone pavements, and of these the parish of St. Mary-lebone is a convenient example. Here the method of construction is as follows. From twelve to fifteen inches of "pitched" (hand-laid) stone is used as a foundation, and is rolled with a ten-ton steam roller.² On top of this are placed nine inches of granite, broken by hand to pass through a two-and one-half inch ring, and after being thoroughly rolled are covered with a thin layer of clayey gravel, known as "hoggin," which is brushed into the interstices of the stone, watered and rolled. Such a road as this costs about 9*s.* (about \$2.25) per square yard, and resurfacing with six inches of stone costs about 3*s.* (about 75 cents) per square yard. The prices paid street laborers in London are about as follows: stone masons, 6½*d.* (about 13 cents) per hour; granite-block pavers, 9*d.*

¹ The English ton is 2,240 pounds.

² Light steam rollers are used in London almost exclusively, because of the nearness to the surface of the city gas mains.

(about 18 cents) per hour; wood-block pavers, $8\frac{1}{2}d.$ (about 17 cents) per hour; rammers, $6\frac{1}{2}d.$ (about 13 cents) per hour; pickmen, $6\frac{1}{2}d.$ (about 13 cents) per hour; steam roller engineer, $5s. 10d.$ (about \$1.45) per day of ten hours; street cleaners, $5d.$ (about 10 cents) per hour; concrete workmen, $6\frac{1}{2}d.$ (about 13 cents) per hour. It is worthy of remark that all laws regarding width of tire in London have been abolished.

Of the Scottish cities, Edinburgh may be taken as an example. Here twelve inches of stone broken by hammer to pass through a two-inch ring are placed on a previously rolled foundation, and rolled with a ten-ton steam roller,¹ street scrapings being used as a binder. Rock delivered on the road costs from $6s.$ to $9s.$ (about \$1.50 to \$2.25) per ton, according to the haul. Such a road, including all expense, costs about $4s. 7d.$ (about \$1.14) per square yard. Foremen get $4s. 6d.$ (about \$1.12) per day; spreaders, $4s. 2d.$ (about \$1.04) per day; pickmen, $3s.$ (about 75 cents) per day. Here, as in England, the wooden block is preferred except on grades.

While the lack of system in the roads of England and Scotland is plainly marked, yet the practical results are extremely good,—probably as good as those obtained in France, although undoubtedly at a far greater cost.

In Holland of course the main avenues of communication are the great system of canals. However, in the Hague, the better streets are paved with thoroughly baked brick laid on a sand foundation. This pavement stands well under the light traffic. The chief pavements in Amsterdam are the Belgian block, which, the writer was told, “never wore out.” No figures could be obtained regarding the cost of road construction, but it is unquestionably small.

In Belgium, although the country roads are not particularly good, yet the streets of Brussels are as fine as any in Europe. They are made chiefly of wood blocks and Belgian blocks, although macadam is also used, and some of the boulevards have strips of each type running parallel. The macadam streets are built of metamorphic sandstone and basalt. The stones are all under two and one-half inches in size, and loam or gravel is used as a binder. A fifteen-ton roller is used. The total cost

¹ Fifteen-ton rollers are used on the country roads.

for the best roads is a little over 4 francs per square metre (67 cents per square yard). The stone block pavement of the best type costs 12 francs per square metre (\$2 per square yard). Labor varies from 4 to 5 francs (80 cents to \$1) per working day of ten hours.

French methods of road construction and maintenance are so well understood that it is hardly necessary to say much here concerning them. The method first employed by Tresaguet in 1764 was introduced into England by Telford in 1820, and is the one known there and in the United States by his name. Many of the earlier roads in France were built according to this method; but the macadam method, which omits the hand-laid foundation, was adopted early in this century by the French, and is the one followed to-day. The stone used is crushed to pass through a six-centimetre (2.36 inches) ring. On account of its great abundance and cheapness, flint is more generally used than any other rock. The depth of crushed stone varies on the different types of road from 15 to 25 centimetres (5.9 to 9.84 inches). Both ten-ton and fifteen-ton steam rollers are used. The difficulty of obtaining the items of cost of road building in France is considerable, but some figures are given in the Appendix.

Full preparations were made in the laboratory this year for carrying out tests on the toughness of rock. Among these preparations was the construction of a special diamond saw for cutting rock cubes. Another plan was for testing the cementing power, on a large experimental scale, of the different types of rock; and for this purpose a great deal of rock had been ground. This work is of necessity brought to a close by the discontinuance of the laboratory.

APPENDIX.

ROAD MATERIALS AND THEIR PHYSICAL PROPERTIES.

It is impossible to find a single material and method of road construction which will suit all conditions. A material and method of construction perfectly adapted to a road in one locality may be entirely unsuited to a road in another. The reason for this is obvious. The traffic may be entirely different in kind, and the local physical conditions may vary in a host of important particulars. The only sure criteria by which to select methods and materials are those obtained by experience, — criteria dearly bought in most instances, and slow of attainment in all. The average constructor of roads must rely to a very great extent on the observations and experience of others. The laboratory tests of road materials, by means of which the physical properties of the available materials may be ascertained from small samples, will permit a rapid and accurate estimation of the value of a material when its physical properties have once been correctly correlated to its behavior on roads.

In the construction of roads, the attempt should be made to get a perfectly smooth surface, not too hard, too slippery or too noisy, and as free as possible from mud and dust; and these results are to be attained and maintained as cheaply as possible. Such results, however, can be had only by selecting the material and methods of construction best suited to the conditions.

When crushed stone¹ is used by the Highway Commission for road building, the best results are generally obtained when rock suited to the conditions is laid in courses on a perfectly drained foundation, sufficiently rolled and properly crowned to shed the surface water, and the finished surface is made to conform to the foundation. The thickest course, which is composed of stones of the largest size, is placed at the bottom; one or more thinner layers of finer stone cover this, and a very thin layer of binder, of screenings of the same stone, is placed on top. Each course is thoroughly rolled before the next is spread over it. Too much attention cannot be given to the binder, for, if it is of a poor quality or improperly used, not only will it be difficult to make the material compact under the roller, but it will not shed the surface water properly, and the coarse stone is sure to work loose and on to the surface in dry weather.

¹ This term is used in preference to broken stone, because the latter term is used abroad only for stone broken with a hammer.

CAUSES OF DETERIORATION IN ROADS.

No matter how well a road material may be suited to the conditions for which it is intended, if the road is poorly constructed and maintained, its deterioration will be rapid.

Effect of Horses' Feet on Roads. — The severe impact to which the surface of a road is subjected by the action of horses' feet tends to loosen the exposed stones and break through the binding surface; the fine material thus loosened is more readily carried off by wind and water, and water can better penetrate through to the foundation. The surface irregularities produced in this way are continually increased by the pounding action of the wheels. The properties necessary to resist this action are, with stone block and brick pavements, high resistance to impact, and with broken stone and gravel, binding or cementing power in the fine material of the surface, — or the word toughness may be used in all cases.

The Action of Wheels. — The effect produced on roads by the wheels of vehicles varies much with the material of which the road is composed and with the character of the traffic passing over it. If the surface of a road is perfectly smooth, and the load per running inch of tire is safely within the limits of resistance of the surface, the amount of wear is probably insignificant, and with crushed-stone and gravel roads it is to a certain extent beneficial. The moment, however, irregularities of any kind occur on the surface, deterioration begins, for the wheels immediately begin to pound, and water accumulates in the resulting depressions.

When the pressure per running inch of tire is too great for a road, bad results soon follow. With crushed stone and gravel, not only should the pressure be within the limits of resistance of the rock of which the road is made, but within the cohesive limit of the binder; for, if this is not the case, the passing wheels cause a shifting movement in the binder, furrowing the road and pressing up the fine material on either side of the furrow. This action is greatly increased by the consequent improper drainage. This furrowing prevents the surface water from properly draining to the sides of the road, and forces it to accumulate on the surface or to make its way to the foundation, and to gully out the road on grades. The pressure of wheels never approaches the resistance offered to compression by the rock composing a road, for, if such were the case, a road would be cut to pieces after a few such loads had passed over it; but it is a very frequent occurrence for the impact of the wheels to go much beyond the limits of resistance of the surface material, and this last-mentioned condition is often met with in city streets.

The binding power of some rocks is to a great extent mechanical, and consequently has no elastic limit or critical point where its bond

is destroyed, but it is compressed a certain amount under a given expenditure of energy, from which it has no power of recovery. The effect of this is very noticeable on some roads, where the vehicles follow in the same tracks; the furrow is increased a certain amount by each vehicle that passes. If the same traffic, however, were distributed over the whole surface of the road, this furrowing would not occur, and the road would to a certain extent be benefited by the compression received. This fact is so important that the commission has found it necessary to attempt to remedy this by placing signs along the State highways, requesting drivers not to keep in the middle of the road, where there seems to be a great tendency to drive.

Weathering, or Chemical Decomposition of Road Materials.—It has frequently been remarked by writers on the subject that the chemical decomposition of the materials plays an important part in the destruction of roads. Where wood or asphalt are used, this may be the case; but the writer is convinced that undue importance has been attributed to this agency as regards other materials.

In a warm, dry climate there is no practical limit to the life of rock. This fact is exemplified by many of the structures of antiquity, such as the pyramids of Egypt (composed of limestone and granite), which have stood for many centuries with the rock undergoing but little change. In such a climate, that would be the case with almost any variety of rock; but in a humid climate, with a wide range of temperature, less durability is to be expected. In all cases, however, the durability is extremely great, as compared with the life of a road.

All rain and surface water contain a sufficient amount of carbonic acid to dissolve carbonates of lime and iron; and, when charged with the humus acids derived from the decomposition of animal and vegetable matter, certain of the rock-making materials containing magnesia, potash, soda, lime, iron, and even silica, are rendered soluble. There is also a small amount of sulphuric acid present in rain water in the vicinity of large cities. The rocks most affected by these reagents are the limestones and arenaceous rocks, having a matrix of lime or iron; but, even with these, resulting disintegration in varieties likely to be used in road building is practically negligible, compared with that due to other agencies to which roads are subjected.

Professor Pfaff of Erlangen subjected to atmospheric erosion specimens of limestone and granite. The annual loss undergone by limestone was estimated to be equal to the removal of a uniform layer from the general surface about .01 mm. in thickness; the granite, .0076 mm.¹ One of the specimens of limestone was broken during a severe hailstorm,

¹ Allgemeine Geologie als exacte Wissenschaft, page 317.

and Professor Geikie considers that so powerful a cause of this nature might make the loss during so short an interval considerably greater than the average of a long period.¹ In the same paper, Professor Geikie, in describing the weathering of gravestones in Edinburgh cemeteries, describes one composed of sandstone in the Greyfriars churchyard as follows: "The original chisel marks on the polished surface of the stone are still perfectly distinct, and the inscribed lettering remains quite sharp. Two hundred years have effected hardly any change upon the stone, save that on the west and north sides, which are the most exposed to wind and rain, the surface is somewhat roughened, and the internal fine parallel jointing begins to show itself." Other instances are cited to show that the parts of stone most exposed to the direct action of wind and rain are most affected, and whenever protected from this action the stone is preserved to a greater or less extent, and in no instance is decomposition mentioned as taking place below the surface of the ground. In referring to granite, he says that it "has been employed for too short a time as a monumental stone in our cemeteries to afford any ready means of measuring even approximately its rate of weathering."

In roads constructed even of the more soluble rocks it can be seen that this action is, from a road-building stand-point, extremely slow. The crushed stone below the surface would be subjected to the action of but little running water, while the amount of the binder that might be taken into solution would be insignificant when compared with that lost through other agencies of wear to which it is subjected. Any one who has observed a cross-section of old limestone road will have noticed that much of the lime taken into solution by the percolation of water from the surface is deposited in the foundation, where it serves the useful purpose of cementing the fragments of stone together.

The writer compared thin sections of diabase (trap) from Medford, Mass., fresh from the ledge, with sections made from the same rock which had been in a road-bed for nine years, and, as far as could be observed with the microscope, no change whatever had taken place in the plagioclase and augite, of which the rock is composed, or the rock as a whole. In specimens of trachyte from Newton, Mass., examined in a similar way, which had been in road-beds for from three to twelve years, no alteration was noticeable. Specimens of felsite from the glacial drift of Saugus, Mass., show but little change from the rock mass from which they were derived. The Saugus gravel, which has the reputation of being one of the best road-building gravels in Massachusetts, is merely glacier-crushed felsite, which

¹ Rock Weathering as illustrated in Edinburgh Churchyards, Proceedings Edinburgh Royal Society, Vol. X., page 318.

has remained near the surface since the glacial period, and is still in an almost perfect state of preservation. The diorite ledges of Nahant, which contain many trap dykes, afford a similar example. They have been exposed to atmospheric erosion in the vicinity of the sea shore certainly for many thousands of years, yet the glacial markings on them are very sharp and distinct.

Richard Muller, as quoted by Merrill,¹ in his experiments on the solvent power of carbonated waters, states that the magnesian silicates were attacked and that hornblende was more easily decomposed than feldspar. Now, these are very important road-metal minerals, and another quotation from the same author is most interesting. In describing the Rogers Brothers' experiments,² he says: "Forty grains of finely pulverized hornblende, digested for forty-eight hours in carbonated water, at a temperature of 60°, with repeated agitation, yielded: silica, 0.08 per cent.; oxide of iron, 0.095 per cent.; lime, 0.13 per cent.; and magnesia, 0.095 per cent., with traces of manganese." Commenting on these results, Bischof remarks³ that "by repeating this treatment one hundred and twelve times, with fresh carbonated water, a perfect solution might be effected in two hundred and twenty-four days." "If, now," he says, "40 grains of hornblende, unpowdered, in which, according to the above assumption, the surface is only one millionth of the powdered, were treated in the same way, and the water renewed every two days, the time required for perfect solution would be somewhat more than six million years." There are many other data which could be presented to show that weathering plays an unimportant part in the destruction of roads constructed of rock, but the above is probably sufficient.

Action of Frost. — Freezing is certainly injurious to road materials that absorb water in any considerable amount, but the effect is probably very small when compared with the destruction wrought by this same agency on the road itself. On freezing, 100 volumes of water expand to 109 volumes of ice, and the force exerted is equal to 150 tons to the square foot if expansion is prevented.⁴ In the table below is given the percentage of water absorbed by some of the important road materials: —

Limestone,	0.20 to 5.00 per cent.
Sandstone,	0.41 to 12.00 per cent.
Granite,	0.07 to 0.16 per cent.
Paving brick,	0.15 to 8.00 per cent.
Wood,	0.16 to 9.00 per cent.
Asphalt,	0 to 0 per cent.

¹ George P. Merrill, *Rocks, Rock Weathering and Soils*, page 192.

² *American Journal of Science*, Vol. V., 1848.

³ *Chemical and Physical Geology*, Vol. 1, page 61.

⁴ Merrill, *ibid.*

There is also collated, in column 5 of Table I., the weights of water absorbed by a cubic foot of stone for each of the important rocks received at the laboratory of the commission.

When we come to examine the subject closely, it becomes apparent that the action of frost on road materials (like that of weathering) is not so great as it at first seems. It can be seen from the accompanying table that the amount of water absorbed by the best materials is small; but, even where the amount is very large, the action of frost does not seem to be markedly injurious. Mr. Beaseley of Peoria, Ill., makes the following statement concerning the effect of frost on paving brick: "The last two years the city of Peoria has conducted freezing tests, which are not completed, but they have gone far enough to see that the average brick could absorb six or eight per cent. and still not be affected by repeated freezings. If the absorption is that high, the brick would be soft, and the wearing away under traffic would be such that the brick should be rejected for paving."¹ Just why brick, stone and wood can absorb as much water as some varieties do, and undergo freezing without disruption, is not altogether clear. It is probable that there is sufficient space for the water to expand into, for the pressure that would otherwise be exerted would often be more than sufficient to fracture the material. To prevent water at zero Fahrenheit from freezing requires a pressure exceeding 40,000 pounds per square inch. It is true that the freezing of water in a vessel in which there is freedom to expand upwards will often fracture the vessel, but this is probably true only where there is a considerable depth of water, and a layer of ice forms on top and increases gradually in thickness till the resistance which it offers to the expansion of the imprisoned water is greater than that of the containing walls, which consequently fracture. In the capillary pores of a rock partly filled with water the volume of water present is not sufficient to reproduce this action, and the water can expand, the air present readily compressing, with but slight increase of pressure. If a material is completely saturated with water, the pressure due to the expansion of the water would cause cubic compression of the material. There is very little direct experimental evidence to show what stress a road material can be subjected to by cubic compression without injury, but it undoubtedly is very much greater than that which it will stand under simple compression. Thus a porous limestone tested at the Watertown Arsenal² withstood a cubic compression of 30,000 pounds per square inch without injury, but broke under simple compression at 9,500 pounds per square inch. It is only at the surface of a rock that there is simple tensile stress, and this probably accounts for the phenomena of concentric weathering.

¹ Proceedings of Illinois Society of Engineers and Surveyors, 1897.

² United States Ordnance Department, Report of Tests of Metals, etc., 1898.

While subjecting saturated bricks, paving blocks, fragments of stone, etc., to a freezing temperature may injure them but little, yet when an entire road surface freezes the effect is very different; for the absorptive power of the road is, with most materials, far greater than that of the material itself, and the strength of the road as a whole is far less than that of its individual components. In the case of pavements which have but little yield, such as brick and stone block on a concrete foundation, the stresses set up by freezing must be very great.

By far the most destructive work of frost is effected on crushed-stone and gravel roads. When the construction is defective or the maintenance poor, water accumulates in the body of the road, which spreads the material so much on freezing that its bond is in some cases destroyed and in other cases much weakened.

During the winter of 1896 a few experiments were made at the laboratory of the commission, to determine the increase in volume of wet stone dust, similar to that composing the binder of roads, when subjected to the action of frost. Compressed briquettes of the dust were saturated with water and exposed to a temperature considerably below the freezing point for over twelve hours; they were carefully measured with a micrometer screw before and after freezing, and were found on the average to have increased in volume by about five-tenths of one per cent., the maximum increase being less than one per cent. The dust was made from a diabase rock fine enough to pass through a screen of 40 meshes per cm. (100 per inch), and the briquettes were subjected to a pressure of 100 kgs. per square cm. (1,422 pounds per square inch), which greatly decreased the capillary voids, but was necessary to insure perfectly smooth surfaces for measuring. There were six briquettes, each containing 25 grms. (.9 of an ounce) of dust and absorbing about 4 cc. (.24 of a cubic inch) of water.

Action of Wind and Rain. — The agencies of destruction to roads which have already been spoken of are alike in one respect, — they cause only abrasion and disintegration to the materials of the road, while wind and rain transport all the loose material brought about by this action. Wind and rain are the chief agents that remove the material from a road, and, as their action is incessant, the loss is consequently very great. From elaborate measurements made by the National School of Roads and Bridges of France, it appears that about seven cubic yards of material per mile per annum are transported from the surface of macadam roads.¹ Besides this action, the accumulation of water on the surface of roads and its constant penetration to the foundation is most injurious.

¹ Personal memoranda.

THE REPAIRING OF ROADS.

Besides the necessity of keeping the surface of a road in good condition, it is essential that the transported material be replaced, for otherwise it would be only a question of time before the road would be completely worn out.

Great care is exercised in France to supply the proper amount and variety of stone to take the place of that worn off. This is done by testing the wearing properties of the rock, and replacing an amount equivalent to the wear as determined by the number of units of traffic passing over the road. This subject, however, will be taken up farther on.

THE DESIRABLE PROPERTIES OF ROAD MATERIALS.

There are a great many properties, good and bad, possessed by road materials, and for this reason the selection of the best material to suit certain conditions is a very difficult matter. It may in many cases depend on a very delicate adjustment of the minor properties; for it is a well-known fact that the rock from different parts and different depths of the same quarry differ much in their properties. This variation we know in many volcanic rocks to have been brought about by a different rate in the cooling of the rock magma, there being practically no chemical change. So little is known on the subject that it is impossible to discuss these minor properties or estimate their importance. It is safe, however, to say that they are sufficiently important to deserve investigation.

There are three properties essential in varying proportions to good road materials, and these only will be considered here. They are: hardness, toughness, and cementing or binding power. Although these properties have been long recognized (at least, hardness and toughness) by those familiar with the subject, yet they have never been properly defined, and the terms have been very much confused. This is not at all surprising, for hardness and toughness are closely allied. It will be well, therefore, to define these terms for our own use, at least, before going further.

Hardness,¹ in relation to minerals and metals, has received much study and has been very thoroughly investigated; but, as is the case with all properties, it can only be measured by comparison. The many methods devised for measuring hardness may be summed under

¹ For a clear exposition of this subject see Dr. T. A. Jagger's paper, *Ein Mikrosklerometer zur Hartebestimmung*, Leipsig, 1898. The writer is much indebted to Dr. Jagger for information here given on the subject.

the following heads: drawing substances under a point;¹ drawing a point over substance, and determining resistance;² grooving with a standard edge, and determining the depth of groove;³ boring substance with a standard point, and ascertaining depth of hole and numbers of revolutions;⁴ grinding with a standard powder, and taking the loss in volume inversely;⁵ compressing lenses on plates of substance, and taking as the hardness the limit of pressure per unit of surface multiplied by the cube root of the radius of curvature;⁶ compressing a point into the substance, and taking the volume of indentation inversely.⁷ Many other tests have been used on these lines, but the above will suffice, for it can be readily seen that few of them bear on the subject in hand. They may all be put under two heads: abrasion and penetration. Unfortunately for us, all of these tests were intended for substances of a perfectly homogeneous nature, and are therefore not at all suited for any of the road materials. Further than this, it can be seen that in their conception of hardness some of the investigators differ much. To permanently deform a substance by compression with a pointed or spherical instrument tests an altogether different property from that opposed to abrasion. But one test has been devised for determining the hardness of road materials, and that, the writer believes, gives the value of this property as understood by road builders in a satisfactory manner. This is the Dorrey test⁸ of the French School of Roads and Bridges, which consists in grinding specimens with sand of a standard size and quality. This method of grinding with a powder has the advantage of being used as a test for hardness by a number of the most able students of the subject,⁹ and at the same time valuable results have been obtained from it on the very class of materials in which we are most interested. We will understand hardness, therefore, to be the resistance which a material offers to the displacement of its particles by friction.

Toughness. — Comparatively little study has been given to toughness from a road-building stand-point, and, except in the laboratory of the commission, no attempt has been made for its direct determination. Toughness is understood here to mean the power possessed

¹ Pekarek, *Sitzungsber.*, v. k. k. Akad. wien, XIII., 1854 (contains complete biography of earlier papers).

² Turner, *Proceedings Phil. Society*, Birmingham, Vol. V., 1886.

³ Pfaff, *Sitz. k. k. Bayer Akad.*, 1883.

⁴ Pfaff, *ibid.*, 1884.

⁵ Rosiwal, *Verhandl. k. k. Geol. Reichsanstalt*, 1896, XVII., 476.

⁶ Auerbach, *Wied. Ann.*, 1891-96.

⁷ Report on Experiments on Metal for Cannon, United States Ordnance Department, 1856.

⁸ Described under laboratory tests.

⁹ Rosiwal, Behrens, Jannettaz and others.

by a material to resist fracture when subjected to impact. This may be due, in a homogeneous, structureless, brittle material, to a relatively low modulus of elasticity combined with high elastic limit. If such a brittle material is incapable of permanent deformation without fracture its elastic strength is the same as its ultimate strength. In this case the resistance to fracture offered by a cube is proportional to the maximum compressive stress, and also to the accompanying deflection. It may be expressed in the following words:—

Let R be the energy of the blow causing fracture; F the modulus of elasticity of the material; P the stress at the elastic limit, which is also the maximum compressive stress; d the strain at the elastic limit; and K some constant.

$$\text{Then} \quad R = K P d$$

$$\text{But} \quad F = \frac{P}{d}$$

$$\text{Therefore } R = K \frac{P^2}{F}$$

That is to say, the power of resisting impact is proportional to the square of the ultimate compressive stress, and inversely as the modulus of elasticity of the material. In actual practice it is extremely difficult to set up simple and uniformly distributed compressive stress by impact. Since comparative rather than absolute results were desired, a special device (an intermediate spherical-end plunger) was used which concentrated the blow on the centre of the upper surface of the test specimen (a condition which could be indefinitely repeated), instead of a flat hammer which would strike the high places on the face of the specimen. The stresses set up in a material as the result of a blow delivered through such a plunger are undoubtedly more complicated than would be the case with a flat-end hammer or plunger; but, as the object of the test is not to obtain any physical constants, but to find comparative powers of resisting impact, that consideration is of small account compared with the advantage of uniformity of conditions and their similarity to those obtaining in actual practice.

Toughness, as understood under this head, would include the property known to road builders under that name, as it is applied to the various road-building rocks and paving brick. These are often heterogeneous materials, and probably owe part of their toughness to the adhesive force between the crystals and the fine particles, — another element of unknown importance.

There is another class of road materials whose toughness is not that combination of properties considered under the above definition. They consist of those materials capable of considerable deformation without rupture when pressed beyond the elastic limit. Asphaltum

and tar practically constitute this class. They distinctly come under the head of tough substances ; but it is obvious that toughness in this sense is viscosity and malleability.. The physical properties of such substances have not been systematically investigated, and their quality is dependent to a great extent on purity.

Cementing or Binding Power. — Binding power is the property possessed by rock dust to act as a cement on the coarser fragments composing crushed-stone and gravel roads. It is possessed in a very much higher degree by some varieties of rocks than by others, and it may be said to depend to a very great extent on compression and the presence of water for its full development. The absence of this property is so pronounced with some varieties of rock that they cannot be made to compact under the roller or traffic without the addition of some cementing agent.

The resistance which the "binding surface" of a road offers to the action of wind and rain, as well as to the wear and tear of traffic, makes this property of the highest value. Further than this, the hardness and toughness of the cemented surface more than of the rock itself represents the hardness and toughness of the road ; for, if a load is sufficient to destroy the bond of cementation of the upper surface, the stones below are soon loosened and forced out of place. The protection from water given to the foundation by some varieties of rock dust is very great. The dust of certain varieties of rock is practically impervious except when water accumulates in depressions of the surface. The writer has examined the foundation of a road built of such a rock after a day and a half of rain and found it perfectly dry. There are other varieties of rock, however, of which quartzite is a good example, which have no power to resist the percolation of water. This property has been studied but little, but it is probably due in a large measure to the resistance offered by the walls of the fine particles, combined with capillary attraction. It seems to accompany cementing value to a great extent.

It is difficult to say what brings about this cementation or binding of rock dust, for the subject has received but little investigation. It is clear, however, that with many varieties of rock it is due to several causes. Experiments made on a number of different kinds of rock dust showed that the more finely they were pulverized the higher would be the cementing value when subjected to pressure, both with and without water ; and an increase in pressure seems to produce a corresponding increase in cementation. Further than this, in a number of cases similarly made briquettes of the same rock dust gave distinct indication that destruction to the bond of cementation by impact bore a definite relation to the amount of energy expended ; *i.e.*, about the same amount of energy was required to destroy the bond in

each briquette, even when applied in different loads. The inference drawn from such results would be that cementation in such materials is to a considerable extent mechanical, — that is, the interlocking of the fine particles of dust caused by pressure.

Another important fact brought out was, that every variety of rock experimented on gave higher cementing results when compressed while wet, which is analogous to the results obtained by road builders, who almost invariably find that the binder of screenings compacts better when watered before rolling. This at first led to the belief that this result was entirely due to a chemical change effected by the water; but briquettes made of pulverized glass, mixed with pure alcohol instead of water, gave practically the same results, although the very slight cementing power of the glass rendered it almost impossible to obtain numerical results. The only explanation of this fact which at present suggests itself is that any mobile liquid which will wet the fine particles of dust acts as a lubricant, allowing them to come in close contact when under pressure. By a process little understood, water has the power of attracting the fine particles of rock dust and cementing them together. This is well illustrated when a drop of water falls on a dry road surface by the dust immediately buckling into an irregular shape, which is retained until destroyed by some force. On examining one of these little clods after drying it will be seen that it sensibly coheres. The solidifying of mud by the drying up of puddles of water on clayey soil is another example, and so this same process can be traced even to the clay concretions. These phenomena may be due to totally different causes; nevertheless, it is the cementation of rock dust, brought about by the presence of water, and in each case the finer the dust the more perfect this action. It may be due to chemical action, to physical rearrangement of the particles, or more likely to a combination of such causes. There also seems to be a tendency for very fine rock dust to assume a gelatinous, plastic state.

This cohesion of the dust particles when wet probably has as much to do with the preservation of roads as any other factor; for when wet the dust better resists the action of wind and rain, and, as already pointed out, it compacts and binds together in this state. This is well illustrated by the necessity of watering roads in dry weather, which in giving protection from dust prevents an enormous loss of material from the road.

Under the head of physical tests will be found a description of a method for testing the cementing value of stone, and in Table I., column 8, are given a number of the results obtained from this test.

LABORATORY TESTS OF ROAD MATERIALS.

During the last thirty years much information has been gathered concerning the value of various materials for road construction, and the physical properties of these materials have been the subject of considerable study and experiment, so that now the road constructor can obtain the laboratory observations which have been compared with actual results on roads. He can, therefore, estimate with reasonable accuracy the value of a new material for a particular service if he knows its laboratory constants. Supplies of road materials are being constantly developed with the growing demand and cheaper transportation, consequently the range of choice and the difficulty of selecting the most suitable material are daily increasing.

Systematic laboratory testing of road materials is of comparatively recent origin. Many of the earlier writers on macadam road building noted the superiority of the wear in certain varieties of rock, and reference is often made to the desirability of hard and tough rock; and as early as the middle of this century compression tests were made on rocks to determine their road-building quality. The systematic testing of road materials may be said, however, to have first started in France, during the seventies, where it has been steadily developing ever since. The Portuguese government was the next to take up the subject, adopting some of the French tests, and conducting them with much precision. The United States is the only other country where this work has been carried on in a systematic way. The testing of paving brick was inaugurated here, and, although no thoroughly standardized test has yet been decided on, careful work is being done at many places. The Massachusetts Highway Commission in 1893 introduced the regular testing of road materials, although a few experiments had been previously made; since then a number of other laboratories have been established. While the importance of the subject has been recognized in England, yet, aside from the limited investigations of a few individuals, almost nothing has been done. The same is true of Germany even to a greater extent, and the other continental nations may be said to have left the subject practically untouched.

TEST OF ROAD MATERIALS IN FRANCE.

A very careful system of tests, of which more will be said later on, was begun on the national roads of France in 1865 to determine the cost and quality of the then available materials. These tests are still being continued. In the latter part of the seventies the commission on national roads decided to introduce in addition certain

mechanical tests at the laboratory of the School of Roads and Bridges, to be conducted parallel with the road tests. A machine for testing the resistance offered by road materials to abrasion and impact had already been used by the street department of Paris. This department found it very useful and reliable for testing the rock used in contract work and for selecting new quarries. This machine (the Deval) was accordingly adopted by the commission for its tests, and a laboratory for testing road materials was founded, which has steadily increased in usefulness, and to-day contains the following tests : —

The Deval Machine. — This machine, as far as the writer has been able to ascertain, was the first machine specially constructed for testing road materials. It was first exhibited at the Paris Exposition of 1878, and then consisted of two iron cylinders, 20 cm. (7.9 inches) in diameter and 34 cm. (13.4 inches) in depth. Each cylinder was closed at one end, and had a tightly fitting iron cover for the other. They were fastened to a shaft, so that the axis of each cylinder was at an angle of 30° with the axis of rotation of the shaft. The shaft which held the cylinders was supported on bearings, and had at one end a pulley-wheel by which the cylinders were revolved, and at the other a revolution counter.

In adopting the Deval machine, the only change made by the School of Roads and Bridges was an increase in the number of cylinders to eight in order to increase the output. The eight cylinders are mounted four by four on two parallel shafts geared to rotate with the same rapidity. This arrangement renders it possible to make eight tests simultaneously. A cut of the French machine is given opposite this page.

The stones employed in making this test are broken to as nearly a uniform size as possible, each fragment being made to pass in all positions through a 6 cm. (2.4 inch) ring. In making a test, 5 kgs. (11 pounds) of rock thus prepared and previously cleansed by washing are used. These stones are placed in one of the cylinders, the cover is then bolted on, and the cylinders rotated at the rate of 2,000 revolutions per hour by means of a gas engine. In rotating, the fragments of stone are thrown from one end of the cylinder to the other twice in each revolution, which causes them to grind and pound against one another and against the ends of the cylinder.

At the end of five hours, or 10,000 revolutions, the machine is stopped, the cylinders opened and the contents emptied into a basin. The cylinder and the cover are carefully washed, and the water used is poured into the basin. Each stone is then washed and brushed under the same water until all adhering dust is removed, which remains in the water as sediment. After drying, the detritus is

sifted into the following three sizes: above 1 cm. (.4 inch), between 1 cm. (.4 inch) and .16 cm. ($\frac{1}{16}$ inch), and below .16 cm. ($\frac{1}{16}$ inch). Only the material below .16 cm. ($\frac{1}{16}$ inch) is used for the purpose of the test, the weight of which is carefully recorded; the others are put aside for reference.

At first a standard rock of superior wearing qualities was always placed in one of the cylinders as a standard of comparison, and the proportion of the weight of the dust under .16 cm. ($\frac{1}{16}$ inch) of the standard rock and the rock to be tested was assumed to give the relative resistance to abrasion of the two stones, — the value sought for. It was found, however, that only the best varieties of rock gave less than 100 grs. (3.52 ounces) of dust; i.e., 20 grs. (.7 ounce) of dust per kg. (2.2 pounds) of rock, or two per cent. of their weight. The number 20 was, therefore, adopted as a standard of excellence, and the "coefficient of wear" for any stone tested may be obtained by the formula: —

$$\text{Coefficient of wear} = 20 \times \frac{20}{w} = \frac{400}{w}$$

where w is the weight in grammes of detritus under .16 cm. ($\frac{1}{16}$ inch) in size obtained per kg. (2.2 pounds) of rock used.

Compression Test. — To the tests made with the Deval machine the following compression test was added. This test is made on 25 mm. (.98 inch) cubes of rock with a hydraulic compression machine. The cubes are sawed at the laboratory from specimens carefully selected to represent the average quality of the rock. This test is made upon at least three cubes of each sample, after desiccation either in the open air or at a temperature of 40° C., or after being saturated with water. The resistance offered by each cube is obtained in kilogrammes per square centimeter of bearing surface, and the average of the results furnished by the different cubes is used.

Experience having shown that the hardest rocks rarely resist a load greater than 3,000 kgs. (6,600 pounds) per square cm. (.16 square inch) section, the commission has adopted the coefficient 20 for the materials having this degree of resistance. (This corresponds approximately to the compressive strength of wrought iron.) The coefficient of any rock may, therefore, be obtained by the following formula: —

$$\text{Coefficient} = \frac{3,000}{20} \times E = 150 E$$

in which E represents the breaking load in kilogrammes per square cm. section.

The cubes used for the crushing test are carefully measured and weighed for determining the density of the stone. This is undoubt-

edly the most accurate of any of the simple methods of determining the density of rock.

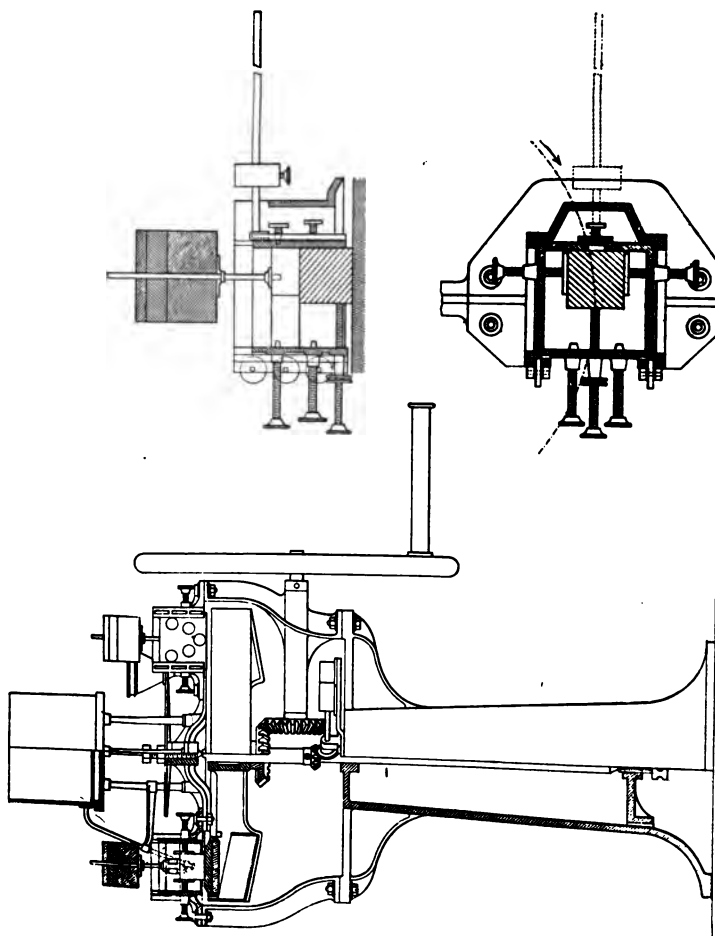
The tests most commonly used for determining the values of paving blocks are the determination of resistance to the wear with a standard sand for hardness, resistance to compression and resistance to impact.

The Dorrey Test. — The test of hardness, or the resistance to wear by rubbing, is made with the Dorrey machine. The specimens to be tested are sawed into rectangular prisms having 4 cm. (1.6 inches) by 6 cm. (2.4 inches) base and 8 cm. (3.2 inches) height. These specimens are placed, two at a time, so that they rest on the upper surface of a circular grinding disk of cast iron, which can be rotated in a horizontal plane by a crank. They are held in clamps so arranged that the bases of the specimens rest on alternate sides of the grinding disk, 26 cm. (10.4 inches) from the centre. The specimens are weighted so that they press against the grinding disk with a pressure of 250 grs. (8.8 ounces) per square centimeter (.4 inch). Sand is fed onto the disk from a funnel above. The sand used is of a standard quality and size, obtained by crushing quartzite rock and screening it to the standard size. The quantity of sand used in each test is one litre per specimen for each thousand turns of the grinding disk. The disk is rotated at the rate of 1,000 revolutions per half hour, and a test is completed in 4,000 revolutions. A cut of this machine may be seen opposite this page.

After 2,000 revolutions the specimens are reversed, in order to ascertain if there is any difference in wear between the two ends, and to make the results approach nearer a general average of the samples. The diminution in the height of the specimen is measured, and its loss in weight determined after each 1,000 turns of the disk. No "coefficient of wear" has been established for this test; it is the loss in height undergone by each specimen after 4,000 revolutions of the grinding disk which is set down as a result of the test, and which serves for comparison. Tests are always made on at least three specimens of each sample, and the final result taken from their average.

The compression test employed for paving stones is made in the same manner as that previously described for macadamizing stone; but, to lessen the expense, the stubs left from the hardness test with the Dorrey machine are redressed into cubes for this test.

Impact Test. — The impact test is made with a machine specially designed for the purpose at the national laboratory. It resembles very closely in principle the pile driver, consisting of a hammer with vertical guides to direct its fall. The hammer is raised by a cord which passes over a pulley at the top of the guides, and can be released at any desired height, from which it falls upon the



DORREY MACHINE OF THE FRENCH LABORATORY.

specimen, which is held below by clamps. Two hammers are employed, one weighing 42 kgs. (92.4 pounds) and the other 20 kgs. (44 pounds); they have, respectively, falls of 100 cm. (40 inches) and 80 cm. (32 inches). The number of blows necessary to crack the specimen and also the number necessary to produce its complete destruction are determined. The test is made upon 4 cm. cubes, at least three cubes being used for each specimen with each hammer. A special device prevents the smaller hammer from rebounding after the blow. Several other tests are occasionally used, though they are not considered to be always necessary with paving stone. They are: the determination of the porosity, together with the effect of frost, and the resistance to breakage by bending.

Tests on Wood-paving Blocks. — For wooden paving blocks the tests most commonly used consist in the determination of their resistance to wear when saturated with water, resistance to compression, resistance to impact, the determination of the expansion by the absorption of water, and the measurement of the thrust exerted when expansion is partially prevented. The specimens for these tests are selected in a similar manner to those of all other tests, — to represent as nearly as possible the average quality of the sample. The test for wear is made with the Dorrey machine, which has been described above, the specimens consisting of prisms of the same dimensions as those used for testing the hardness of paving stones. The specimens are placed in the machine with the grain of the wood at right angles to the grinding disk. The only difference in the conduct of the test is that emery is used as the grinding agent instead of quartz sand. Only the loss in height of the specimen is recorded.

The compression test is made with a hydraulic press upon prismatic specimens, with the base 8 cm. (3.2 inches) square, and a height equal to that of a paving block, the grain of the wood being parallel to the direction of the load. The test specimens are either dried at a temperature between 30° and 40° C., or they are saturated with an amount of water equal to that absorbed by a paving block in actual use, this amount having been determined experimentally.

The resistance to impact is made with the machine described above upon prisms having a base of 6 cm. (2.4 inches) square and a height equal to that of a paving block. The test piece is placed in a cast-iron case 7 cm. (2.8 inches) square, open both at the top and bottom, and is held in place by a resinous cement which completely surrounds it, the top of the prism projecting about 1 cm. (.4 inch) above the case. The 20 kg. (44 pound) hammer is employed in this test, with a height of fall of 200 cm. (80 inches). The number of blows of the hammer which cause an appreciable breakage, as indicated by a smaller rebound of the hammer and a diminution in the height of the

specimen, is made note of. Three dried and three wet specimens are subjected to this test.

For determining the strength of thrust caused by absorption when expansion is partially prevented whole paving blocks are used.

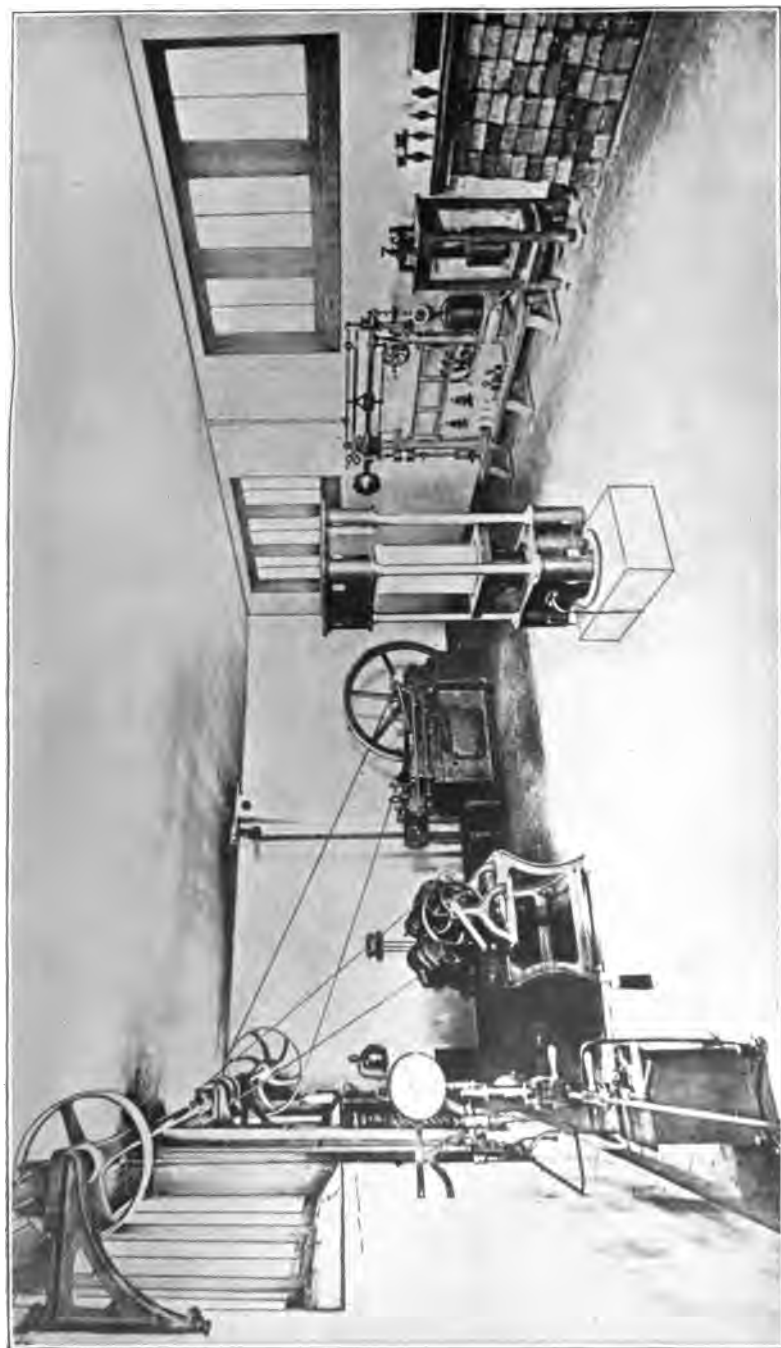
The special device used for this test is as follows: the paving block, after thorough desiccation, is placed in a water-tight receptacle and held between two plates at top and bottom, so that the top face of the paving block rests against a block of cast iron, which is stationary. The lower plate is supported on the small lever arm of a cement-testing machine. Water at a temperature of 30° C. is poured around the paving block, and as dilation takes place the lever arm of the machine tends to rise. When it rises it opens a valve through which mercury pours into a vessel supported at the end of the arm till the arm comes back to mid-position, when the valve is closed. As the position of the lower plate is fixed when the long lever is in its mid-position, and as this arm is always kept automatically in that position, the specimen is entirely prevented from longitudinal extension. The weight of the mercury in the vessel at the end of the lesser arm is at any moment a measure of the force exerted by the test piece; and, as the vessel is supported by a spring balance, the force exerted by the paving block can be read at any time. Observations are made at first at intervals of three hours; then, as absorption goes on and the consequent increase of the thrust becomes less rapid, at intervals of twelve hours; and finally at intervals of twenty-four hours, till all increase ceases. It will be seen that this does not reproduce closely the condition existing on actual roads, as in that case the block is only free to expand in one direction, viz., upwards; whereas during the test the specimen is free to expand in all directions except longitudinally. Nevertheless, the results are of value in giving some indication of the amount of thrust to be expected on actual roads. After the test the specimens are weighed to ascertain how much water has been absorbed.

No mechanical tests have yet been devised, or considered necessary, for asphalts. Chemical analyses are made, however, to determine the proportion of bitumen, sand, calcium carbonate, clay, pyrites, etc.

TESTS OF ROAD MATERIALS IN PORTUGAL.¹

The laboratory testing of road materials was first taken up in Portugal in 1881, in the district of Santarem. The Deval test of the French School of Roads and Bridges was adopted, and over sixty varieties of stone were tested. The basalt, diorite and certain of the

¹ *Jornal dos Engenheiros Civis Portuguezes*, Vol. XIII., page 150, 1882. *Revista das Obras Publicas e Minas*, Vols. XIII. and XXIV.



MAIN TESTING ROOM OF THE FRENCH LABORATORY.

granites from the valley of the Tagus gave "coefficients of wear" as high as 24; which is superior to that of the flint, which previous to the test was thought to be the best road stone, but subsequent trials on the road have proved this to be a mistake. The coefficients of the limestone tested ranged from 2 to 17. Those from 10 to 17 gave good results on roads where the travel was light; those below 10 were found to be too soft.

Compression tests are also carried on at the laboratory for testing materials at Lisbon, which is equipped with three compression machines. The tests can be made on 10 cm. (4 inch), 7 cm. (2.8 inch) and 5 cm. (2 inch) cubes, according as necessity demands; but the smaller cubes are generally used for testing road materials, which are crushed both dry and wet. No coefficient is worked out for this test; the number of kilogrammes per square centimeter required to destroy the cube is used for comparison. All test samples are sent to the laboratory by the directing engineer of the district from which they come.

The results of these laboratory tests have been compared with limited observations to the actual wear of roads, which will be referred to later, and they were found to agree very well.

TESTS OF ROAD MATERIALS IN THE UNITED STATES.

Doubtless a number of experiments and tests of one sort and another have been made in a limited way on road materials in this country; the earliest recorded test, however, is that conducted at St. Louis some years ago in the following manner: —

Sections of road were built of the different materials, 22 inches wide and 8 feet long. Two wheels, with tires $2\frac{1}{2}$ inches wide and loaded to 2 tons or 800 pounds per inch width of tire, were made to pass back and forth over these sections by machinery. The heaviest traffic at that time in St. Louis was 75 tons per day per foot of width, and the average for business streets was 35 tons. Estimating the effect of horses' shoes at one-third of this amount, 50 tons per foot was taken as a standard. The samples were weighed before and after testing, and were subjected to an amount of wear by the wheels estimated to be equal to eight and a half years on the street. The total abrasion of the fire-brick pavement was 9 per cent., or a depth of $\frac{3}{4}$ of an inch, but about one-half of the brick were broken. Asphaltum blocks under the same test wore 14 per cent., and but one was broken. Broken stone lost 1 per cent. under a traffic of 12.7 tons per foot of width. Broken stone and sand lost 1 per cent. under 16 tons per foot. Limestone block lost 1 per cent. under 4,400 tons per foot of width. Wood blocks lost 1 per cent. under 12,900 tons per foot, and the granite blocks lost 1 per cent. under 70,000 tons.¹

¹ A Treatise on Highway Construction, Austin T. Byrne, page 25, 1893.

While the above test is very interesting and instructive, it is not altogether satisfactory. The evident design is to approximate the condition obtaining in practice, and in this respect it is deficient. The weight per inch of tire is greatly in excess even of the heaviest steam roller, and in consequence the materials are stressed in a manner far exceeding the normal. Such heavy loads on road materials are very different in effect from the ordinary loads of practice, and this is clearly shown in the case of the fire brick, where more than half the number used in the test were broken. The effect of horses' feet on roads is a subject on which very little is known, and it is exceedingly doubtful that one-third of the total wear is a fair estimate for this, — certainly with many materials it amounts to more than one-half. The effects of the elements which are most destructive to roads are in no way considered.

Laboratory of the Massachusetts Highway Commission. — Shortly after the founding of the Massachusetts Highway Commission, in 1893, a laboratory was established at the Scientific School of Harvard University to aid the commission in selecting materials for the State highways, the university furnishing without charge the necessary power and appliances. The various tests carried on by the commission are described below: —

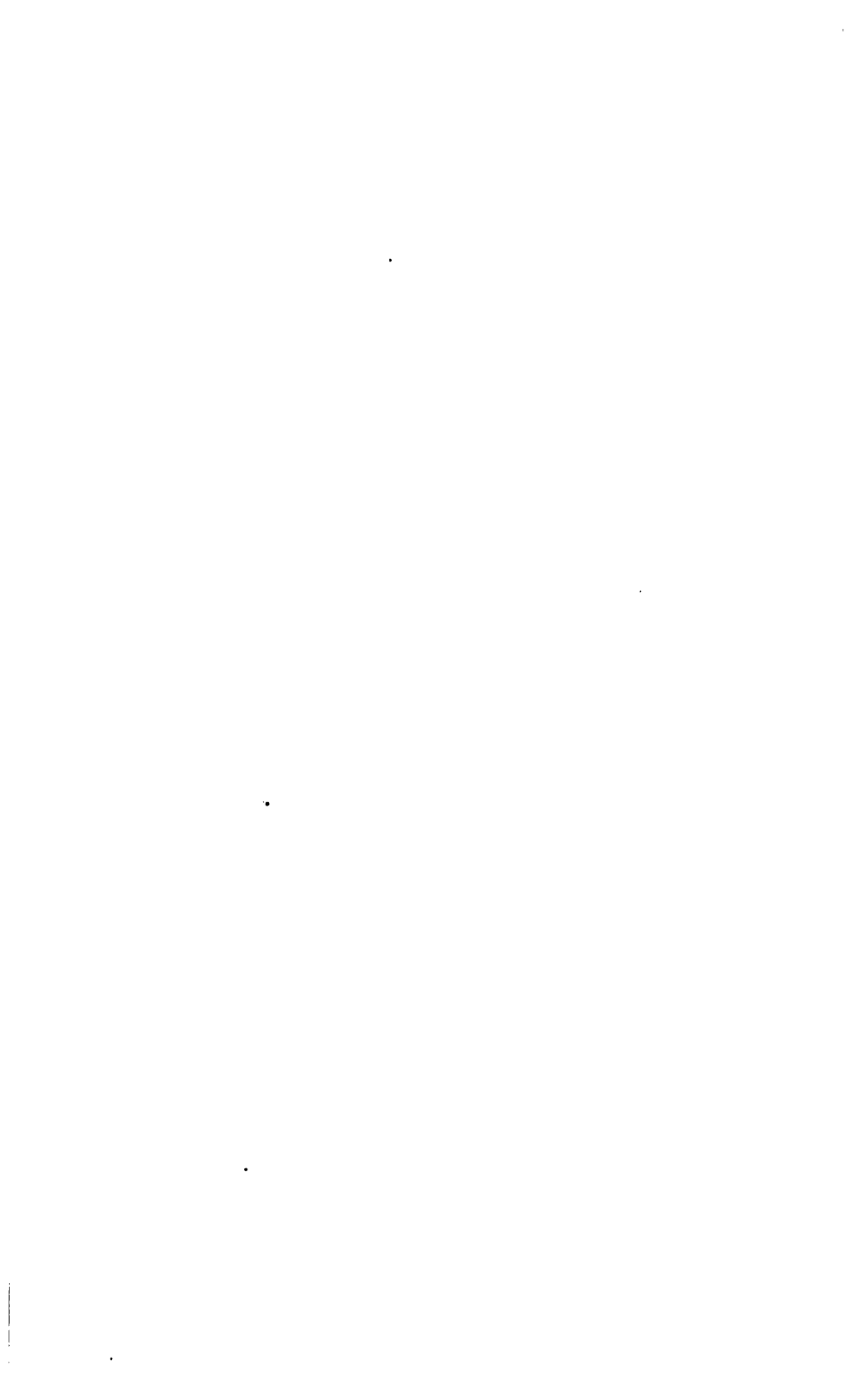
Abrasion Test. — This test is almost identical with the Deval test previously described, the only difference being the omission (to save time) of certain processes not strictly necessary, and a few modifications in the machine to simplify its operation and lessen its cost of construction. A full description and account of this machine is given in the annual report of the commission for last year. The cylinders of this machine, which are four in number, of the same internal dimensions as the Deval, as well as the shaft, are made of cast iron. A cut of this machine can be seen opposite this page.

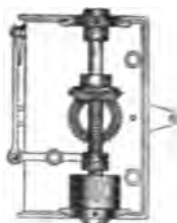
When the machine is stopped, after 10,000 revolutions, its contents are placed on a sieve having .16 cm. ($\frac{1}{16}$ inch) mesh. The material that passes through the sieve is put aside for the cementation test; the sieve and the remaining fragments of stone are then held under running water until all the adhering dust is washed off. After the remaining fragments have thoroughly dried they are carefully weighed, and their weight subtracted from 5 kgs. (11 pounds), the original weight of all the rock in the test. The difference obtained is the weight of the detritus under .16 cm. ($\frac{1}{16}$ inch) worn off by the test. The percentage of the .16 cm. detritus may be taken as a coefficient of comparison, or the French coefficient of wear may be determined by the formula already given. Tests have been made on samples of stone with this machine, the results of which, both in the



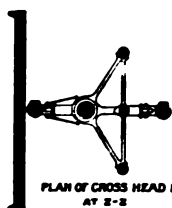
ABRASION MACHINE OF THE MASSACHUSETTS HIGHWAY COMMISSION.





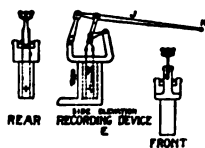


PLAN OF TOP

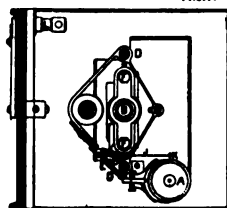


PLAN OF CROSS HEAD I
AT Z-Z

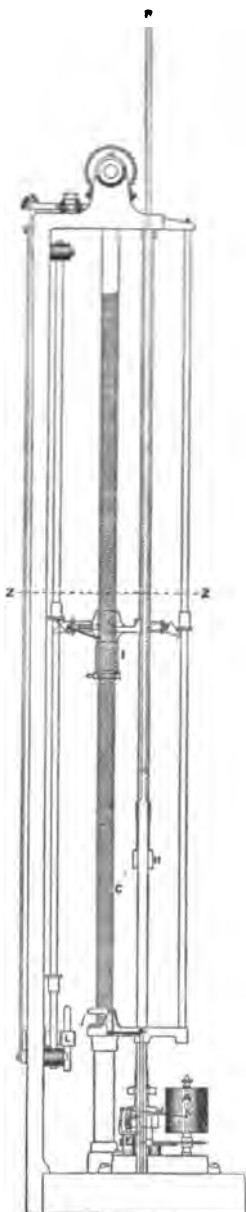
IMPACT TESTING MACHINE



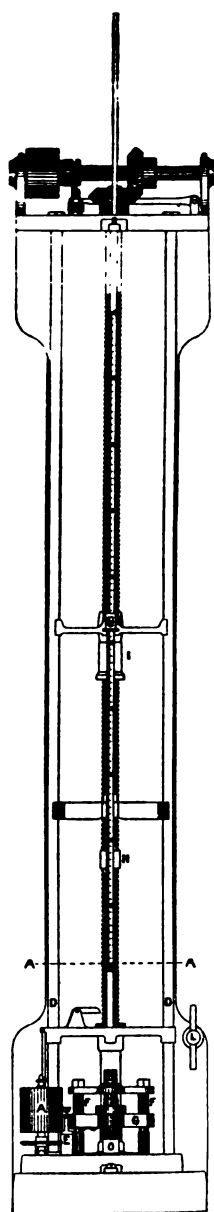
REAR
FRONT
SIDE SUPPORT
RECORDING DEVICE
E



SECTIONAL PLAN A-A



SIDE ELEVATION



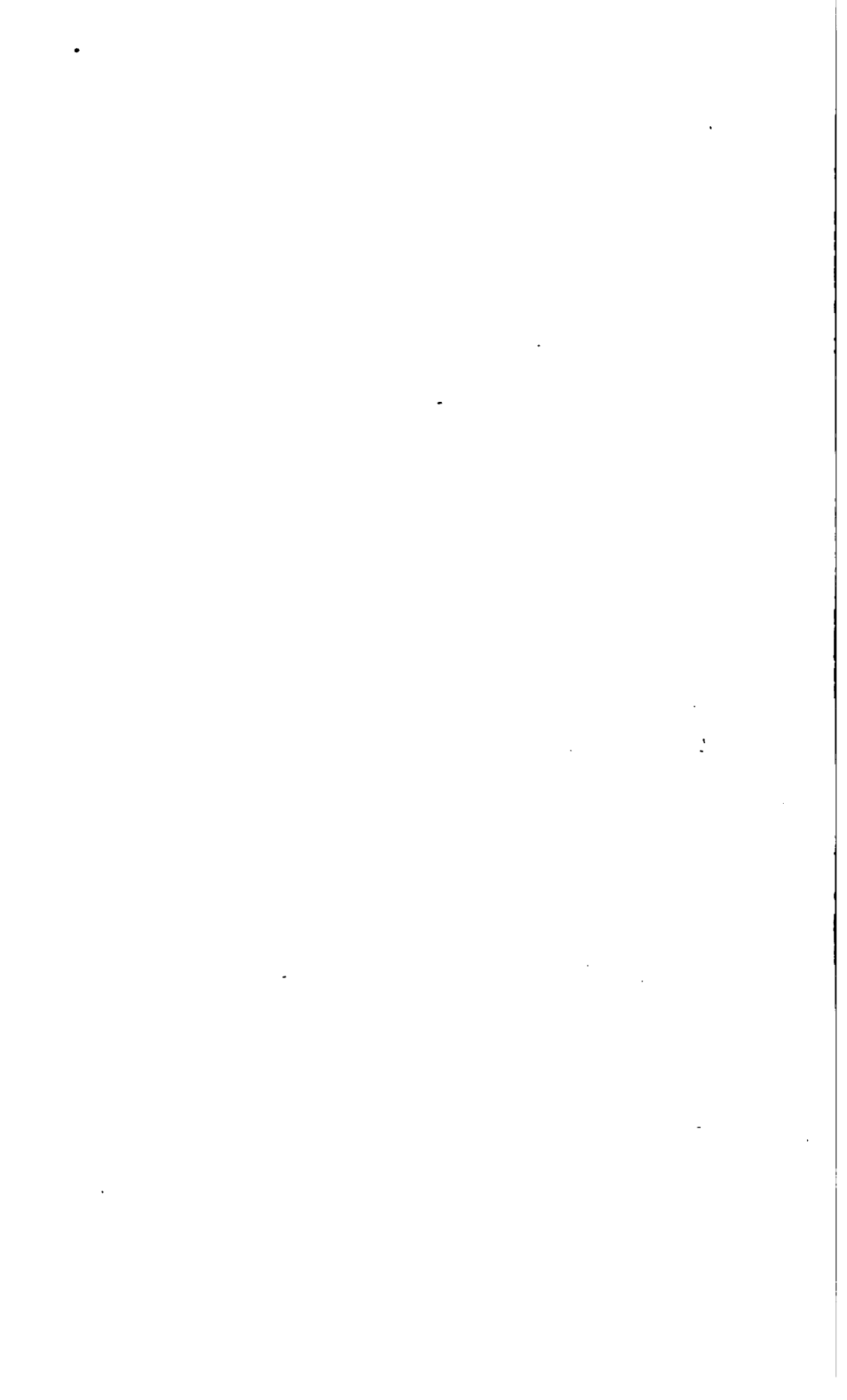
FRONT ELEVATION

percentage of wear and in the French coefficient, can be found in columns 7 and 6, respectively, of Table I.

Cementation Test. — The important cementation or cohesive property of road materials has already been discussed, but it will be well to state that, although its importance has long been recognized, it has never been investigated except in this laboratory. The test adopted by the commission is an impact test to which stone dust briquettes are subjected, which is as follows: —

To make a briquette, the dust of rock that is to be tested is passed through a screen with 40 meshes per cm. (100 per inch), and is obtained either from the detritus of the abrasion test or by specially reducing the stone. This reduction can be accomplished by placing some fragments of the stone in one of the cylinders of the abrasion machine, together with a flat-end steel hammer of about 10 pounds weight, and allowing the machine to run until a sufficient quantity of the stone is pulverized. The dust is made into briquettes of circular sections 25 mm. (.98 inch) in diameter and 25 mm. in height by placing the dust in a metal die of the proper dimensions, with enough distilled water to moisten it (4 cc. or .24 cubic inches); a closely fitting plug is then inserted on top of the wet dust and it is subjected to a pressure of 100 kgs. per sq. cm. (1,422 pounds per square inch). The weight of the dust varies with the density and compressibility of the stone, but generally it requires about 25 gra. (.9 ounce) of dust to make a briquette of the above dimensions. Two weeks should be allowed for a briquette to dry, at the ordinary temperature of a room, after which it should be tested within a few days.

The machine specially designated for this test, a cut of which can be seen opposite this page, consists of a 1 kg. (2.2 pound) hammer (H), arranged like the hammer of a pile driver on two vertical guides (D). The hammer is raised by a screw (C), and dropped automatically from any desired height. It falls on a flat-end plunger (B) of 1 kg. weight, which is pressed upon the briquette (O) by two light spiral springs held by the guide rods (F). The plunger (B) is bolted to a cross-head (G), which is guided by two vertical rods (F'). A small lever (J), carrying a brass pencil (K) at its free end, is connected to the side of the cross-head by a link motion, arranged so that it gives a vertical movement to the pencil six times as great as the movement of the cross-head. The pencil is pressed against a drum (A), and its movement is recorded on a slip of silicated paper fastened thereon. The drum is moved automatically through a small angle at each stroke of the hammer; in this way a record is obtained of the movement of the hammer after each blow. The standard fall



This shaking device is necessary to prevent the finer meshes of the screen from getting clogged with dust. Dust can be sifted very rapidly with a screen of this kind, and, as the cylinder is completely covered, no dust can escape into the air.

Compression Testing Machine. — There are two compression testing machines belonging to the university, which are used when occasion demands. One is an Olsen, with a capacity of 200,000 pounds; the other is a Riehlé, with a capacity of 60,000 pounds. The Olsen is better adapted for heavy work, such as testing paving stones and vitrified brick; the Riehlé, for making stone-dust briquettes and all lighter work.

Power for operating Machinery. — Of the various engines and motors in the laboratory, the one generally used for operating the machines described above is a 3 horse-power steam engine. On occasions when there is no steam, a $3\frac{1}{2}$ horse-power gas engine is used.

Absorptiveness of Rock. — The method used for determining the absorptiveness of rock is a very simple one. It is not intended at all to give the porosity of rock, but merely to obtain the number of pounds of water absorbed by a cubic foot of rock in ninety-six hours, determined from a small specimen. The process consists of taking a smoothly worn stone, between 20 and 60 gms. in weight, that has been through the abrasion test, and weighing it in air. It is then immersed in water and immediately reweighed in water. After ninety-six hours of immersion it is again weighed in water.¹ The absorption is obtained by the following formula: —

$$\text{No. of pounds of water absorbed by a cubic foot of rock} = \frac{C - B}{A - B} \times 62.5$$

in which A is equal to the weight in air, B the weight immediately after immersion in water, C the weight after absorption for ninety-six hours, and 62.5 the weight of a cubic foot of water.

The method first used by Gilmore,² and later by Winchell³ and Williams, differs from this method, in that the stone used in the test was taken out of the water in which it was immersed and its surface dried with a filter paper, and its weight taken every twenty-four hours until absorption ceased. The absorptiveness was expressed in figures, by giving the number of parts by weight of stone required to absorb one part by weight of water.³

The method used by the commission is in no way better than this,

¹ It was found by experiment with a number of specimens that absorption practically ceased after sixty-two hours, so ninety-six was given as a safe allowance.

² A. A. Gilmore, in his report on building stones of United States, 1875, page 8.

³ J. F. Williams, Annual Report Arkansas Geological Survey, 1890, page 47.

except that it requires less manipulation and time, and the result is a little more practical. Column 5, Table I., gives the absorptiveness of about all the important rocks received at the laboratory.

Petrographic Determination of Specimens. — In order to determine the composition and classify samples of rock sent to the laboratory, it is in many cases necessary to make thin sections of the rock for petrographic examination. This work is done in the petrographical laboratory of the university, which is supplied with a diamond saw, a corundum saw and numerous grinding disks, all of which are run by a 5 horse-power electric motor. Here also the cubes of stone used in the impact and compression tests are sawed and shaped. This laboratory is also equipped with microscopes specially adapted for determining the mineral composition of rocks.

The petrographic determination of rock is very important to road building, for it is the simplest method by which rocks can be properly named and classified. The confusion arising from the impossibility of determining rocks of totally different properties with the unaided eye is very great, and in many cases leads to costly mistakes in the selection of road materials. The use of general terms, such as trap, granite, porphery, blue stone, etc., is very confusing, and they are used differently in different localities.

The microscopical analyses which have been made up to the present time on specimens received at the laboratory have been arranged to give the percentages of the minerals of which each rock is composed.¹

The writer is convinced that much is to be derived from this method of investigation, if properly carried out on the road-building rocks.

THE TESTING OF PAVING BRICK.²

For the past ten years much valuable work has been done on the testing of paving brick. This work has been carried on almost entirely by the engineering departments of colleges and city governments in the western States. Up to the present time these tests have consisted chiefly of the resistance offered to abrasion with the "rattler machine," resistance to compression, and porosity. Only the "rattler test" will be spoken of here.

The committee of the National Brick Manufacturers' Association, after making extensive tests, made the following recommendation, which was adopted by the association: That the rattler test be made the chief test, and that it be made without shot of any kind. The

¹ See Sixth Annual Report Massachusetts Highway Commission, page 70.

² Much reliable information can be found on this subject from the following sources: Report of the Committee on Paving Brick Specification and Tests; Standard Methods of Testing Paving Brick, A. N. Talbert, University of Illinois; Annual Report of City Engineer of Peoria, Ill., 1893-94; Engineering Record, March 4, 1899, and April 1, 1899.

standard rattler should be 28 inches in diameter by 20 inches in length, but rattlers of from 26 to 30 inches in diameter and 18 to 20 in length could be used. The cross-section of the rattler should be of polygonal shape, having from 12 to 16 sides, and the shaft should not be allowed to pass through the chamber. The charge for a test should consist of but one kind of brick, which should occupy 15 per cent. of the chamber of the rattler. The number of revolutions of the rattler required for a test is 1,800, at the rate of 30 per minute; and the result to be determined is the per cent. of loss by weight obtained from the average of two distinct tests.¹

Many investigators have ably supported the use of cast-iron shot in this test for increasing the wear and impact; and the National Brick Manufacturers' Association subsequently adopted another standard, in which cast-iron shot are used.

The difficulty in determining standards for paving-brick tests which would be universally acceptable would be greatly aided if tests with the different varieties of brick were made on the road at the same time.

LABORATORY TESTS IN OTHER COUNTRIES.

There is but little to be said regarding the laboratory tests on road material which have not already been mentioned. In England there are numerous testing plants for testing the strength of materials, of which David Kirkaldy & Son are notable examples, who for many years have made compression tests on rock cubes. There are also a few persons who have carried on private investigation on road testing, but probably the only machine specially designed for testing road rock is the Mead machine. "This consists of an iron cylinder, about 12 inches in diameter and 20 inches in length, with a hand-hole on one side. There are three iron angle bars bolted to the inner side of the cylinder at equal distances apart. The cylinder is fixed on a shaft, and is worked at about 20 revolutions per minute. The macadam to be tested is carefully washed and placed in the machine with a small quantity of water. After working two hours (2,400 revolutions) the stone is taken out and the loss by weight ascertained; the condition of the macadam is also taken into account, — the soft or inferior stone will wear round, whilst the harder kind of stone retain their angular form."²

The small number of results obtained from this machine, together with its greater cost of construction, will hardly make it a substitute for the Deval test, the general method of which is very similar.

Besides a limited number of compression tests and the collection of

¹ Standard Methods of testing Paving Brick, Prof. A. N. Talbert.

² Special Ministerial Report.

data concerning the physical properties of rocks by Prof. Johann Bauschinger of Freiburg, almost nothing has been done on this subject in Germany.

Although nothing has yet been accomplished in Austria, the necessity for testing road materials has been thoroughly realized, and the establishment of a government laboratory at Vienna for this purpose is at present being considered.

THE TESTING OF MATERIALS IN ACTUAL USE ON ROADS.

In 1865 tests were begun on the national roads of France, to determine the quality of the various materials of construction, and ultimately ascertain for each department the materials best adapted for its roads. Careful measurements were taken of the depth of stone for all the national roads by digging trenches, alternately from one side of the road and the other at intervals of 200 metres (219 yards). These trenches were cut from the centre to the side of the road, so as to give a complete section of one-half of the road. This test was repeated in 1874, 1886 and 1891, the last measurements amounting to over a half million in number. These measurements were taken for the purpose of determining accurately the amount of stone worn off annually. At the same time a census was taken of the traffic passing over each road. Each division engineer was also required to build short sections of road of each available rock in his district along the same line of travel. All the materials of construction and maintenance were carefully measured, and the results of wear were obtained.

Observations were taken over 22,000 miles of road. The traffic was classified and rated as follows:—

1. Each horse hauling a public vehicle or a cart loaded with produce or merchandise, 1.
2. Each horse hauling an empty cart or a private carriage, $\frac{1}{2}$.
3. Each horse, cow or ox unharnessed, and each saddle-horse, $\frac{1}{2}$.
4. Each small animal (sheep or goat), $\frac{1}{10}$.

A record of traffic was made every thirteenth day throughout the year, and an average taken to determine the amount of traffic. The general average over all the roads in 1893 was 170.6 units of travel. To repair the road there had been required an average of 49 cubic yards per mile and per 100 units of travel per year. The detailed reports of this work are published in the official reports of the Minister of Public Works of France,¹ and offer a body of material which, when combined with the results of laboratory tests, should be of great value in determining the value of such tests.

¹ A. P. Rockwell, Roads and Pavements in France.

In Portugal some attempt has been made to determine on a large scale the wear of the roads and its relation to the laboratory tests. A census of the traffic was kept at the toll gates, and the wear was determined by making observations of the thickness of the road whenever it had to be cut through for the purpose of laying pipes and so forth. The results of these observations have not been published, but in a ministerial report supplied to the United States government it is stated that the laboratory tests indicated very clearly the best materials for use on roads.

It is evident, from the experience of the Massachusetts Highway Commission, that a road material cannot be selected irrespective of the kind and amount of traffic to which it is to be subjected. Thus the Nantucket road was made partly with Hudson River (Palisade) trap, an extremely good road material for heavy wear. It was found, however, that the road would not stay down, but loosened or unravelled, on account of the traffic being insufficient to keep it down, and that notwithstanding an unusually great amount of rolling. It was finally necessary to put on limestone screenings. Similarly, two other roads, the Wilbraham road, made with Westfield trap, and the Turner's Falls road, made with Deerfield trap, both country roads with but light traffic, have had to be rerolled several times. They would doubtless have been quite satisfactory if subjected to heavier traffic.

It is obvious, then, that to secure the proper road materials an estimate of the amount of traffic should be made, based preferably upon observation, and also upon the deviation, and consequent increase of traffic which a good road causes. A small expenditure for such an estimate may save a considerable sum in repairing and rebuilding a road which has been made of an unsuitable material.

TABLE I.

LOCALITY OF STONE.	Name of Stone.	Number of Specimen.	Weight of a Cubic Foot of Stone (Pounds).	Pounds of Water Absorbed per Cubic Foot of Rock.	Coefficient of Wear.	Percentage of Wear.	Cementing Value.	Used on State Highway.
Acushnet,	Field stone (erratics),	205	-	-	9.32	4.29	9	1897 lay-out.
Amherst,	Diabase (trap),	78	186.88	.07	20.33	1.97	62	1897 lay-out.
Andover,	Mixed stone,	210	-	-	10.29	3.88	19	1899 lay-out.
Andover,	Field stone (erratics),	319	-	-	10.41	3.84	-	1899 lay-out.
Ashby,	Granite,	60	166.25	.19	8.41	4.76	6	-
Ashby,	Field stone (erratics),	187	-	-	5.43	7.36	12	1896 lay-out.
Ashby,	Gneiss,	118	164.38	.25	6.08	6.57	1	-
Ashby,	Field stone (erratics),	209	-	-	7.31	5.47	15	1897 lay-out.
Ashby,	Field stone (erratics),	283	-	-	5.84	6.84	-	1898 lay-out.
Athol,	Biotite schist,	88	167.50	.13	12.52	3.19	-	-
Auburn,	Hornblende gneiss,	203	165.00	.18	12.50	3.20	14	1897 lay-out.
Balfour, N. C.,	-	323	-	-	11.04	3.62	-	-
Barnstable,	Mixed stone,	325	-	-	11.49	3.48	-	1899 lay-out.
Bedford,	Mixed stone,	241	-	-	16.69	2.40	14	1897 lay-out.
Bergen Hill, N. J.,	Trap,	249	186.25	.45	15.03	2.66	26	-
Bernardsville, N. J.,	Limestone,	287	168.75	1.49	9.71	4.12	-	-
Beverly,	Granite,	74	-	-	21.16	1.90	-	-
Beverly,	Diabase (trap),	117	180.00	.17	16.71	2.39	14	1896 lay-out.
Beverly,	Hornblende granite,	89	171.25	-	17.48	2.29	-	-
Beverly,	Mixed stone,	271	-	-	19.13	2.09	-	1898 lay-out.
Beverly,	Granite,	62	172.50	.21	14.58	2.75	5	-
Boston,	Felsite,	40	166.88	-	16.06	2.49	-	-
Boundbrook, N. J.,	Basalt (trap),	252	181.88	.17	18.61	2.15	16	-
Bourne,	Field stone (erratics),	275	-	-	10.50	3.80	-	1898 lay-out.

TABLE I.—Continued.

LOCALITY OF STONE.	Name of Stone.	Number of Specimens.	Weight of a Cubic Foot of Stone (Pounds).	Pounds of Water absorbed per Cubic Foot of Rock.	Coefficient of Wear.	Percentage of Wear.	Cementing Value.	Used on State Highway.
Dennis,	Field stone (erratics),	180	—	—	19.19	2.08	13	1896 lay-out.
Dennis,	Field stone (erratics),	221	—	—	15.98	2.50	6	1897 lay-out.
Dennis,	Field stone (erratics),	268	—	—	14.11	2.90	20	1898 lay-out.
Duanesburg, N. Y.,	Sandstone,	94	165.13	1.35	10.53	3.80	13	
Duxbury,	Gneiss,	5	166.25	.20	13.46	2.97	7	
Duxbury,	Field stone (erratics),	217	—	—	9.21	4.34	16	1897 lay-out.
East Providence, R. I.,	Grit (carboniferous?),	43	167.50	.49	9.57	4.18	—	
East Providence, R. I.,	Grit (carboniferous?),	48	170.68	.21	13.43	2.98	—	
Edgartown,	Field stone (erratics),	235	—	—	8.70	4.60	23	1897 lay-out.
Everett,	Olivine diabase,	2	179.38	.11	13.87	2.88	—	
Fitchburg,	Granite,	256	158.75	.34	17.90	2.23	12	1897 lay-out.
Florida,	Styite,	119	176.88	.19	2.02	19.78	—	
Florida,	Mixed stone,	120	175.63	.22	6.70	5.96	19	
Glen Mills, Penn.,	Metamorphic sandstone,	254	198.13	.05	14.48	2.76	20	
Gloucester,	Hornblende granite,	26	164.38	.15	11.03	3.63	—	
Gloucester,	Augite nepheline syenite,	30	171.25	.09	12.63	3.17	—	
Gloucester,	Field stone (erratics),	170	—	—	13.34	3.00	5	1895 lay-out.
Gloucester,	Mixed stone,	272	—	—	11.29	3.54	—	1898 lay-out.
Gordon County, Ga.,	Chert,	88	—	—	8.35	4.79	—	
Grafton,	Field stone (erratics),	223	—	—	14.84	3.37	20	1897 lay-out.
Great Barrington,	Limestone,	47	173.13	—	9.53	4.20	—	
Great Barrington,	Biotite gneiss,	80	166.88	.30	14.62	2.74	28	
Great Notch, N. J.,	Diabase (trap),	260	182.50	.09	21.76	1.84	40	
Great Notch, N. J.,	Diabase (trap),	261	185.00	.23	18.59	2.15	36	

TABLE I. — Continued.

LOCALITY OF STONE.	Name of Stone.	Number of Specimen.	Weight of a Cubic Foot of Stone (Pounds).	Pounds of Water Absorbed per Cubic Foot of Rock.	Coefficient of Wear.	Percentage of Wear.	Cementing Value.	Used on State Highway.
Lynn,	Felsite,	24	165.63	.25	14.66	2.73	-	
Lynn,	Felsite,	27	-	-	12.30	3.26	-	
Lynn,	Diabase (trap),	29	186.26	-	18.17	2.30	-	
Malden,	Diabase (trap),	270	-	-	18.86	2.12	-	1897, 2d lay-out, Revere.
Malden,	Hornblende granite,	125	165.00	.10	14.09	2.84	16	
Manchester,	Hornblende granite,	112	-	-	9.06	4.41	-	
Marion,	Mixed stone,	113	-	-	9.95	4.02	-	
Marion,	Field stone (erratics),	201	-	-	8.44	4.73	7	1897 lay-out.
Marion,	Field stone (erratics),	393	-	-	-	-	-	
Marlborough and Northborough,	Field stone (erratics),	255	-	-	13.67	2.92	20	1897 lay-out.
Marshfield,	Field stone (erratics),	179	-	-	7.90	5.05	22	1894 and 1896 lay-outs.
Marshfield,	Field stone (erratics),	297	-	-	16.00	2.50	-	1898 lay-out.
Mattapoisett,	Field stone (erratics),	106	-	-	8.78	4.55	-	
Medford,	Diabase (trap),	20	191.88	.10	15.82	2.53	-	
Meriden, Conn.,	Diabase (trap),	11	177.50	.69	12.60	3.30	-	
Meriden, Conn.,	Diabase (trap),	71	171.25	.18	15.49	2.53	28	
Methuen,	Sandstone (siliceous),	181	167.50	.23	14.00	2.86	11	1896 lay-out.
Methuen,	Sandstone (siliceous),	226	171.25	-	18.68	2.14	12	1896 lay-out.
Merrimac,	Field stone (erratics),	288	-	-	14.16	2.82	15	1897 lay-out.
Merrimac,	Sandstone,	329	-	-	12.92	3.09	-	1898 lay-out.
Mechanic Mt., N. J.,	Trap,	284	191.25	.06	20.00	2.00	-	
Middleborough,	Field stone (erratics),	177	-	-	7.99	5.00	12	1896 lay-out.

TABLE I. — Continued.

LOCALITY OF STONE.	Name of Stone.	Number of Specimens.	Weight of a Cubic Foot of Stone (Pounds).	Pounds of Water Absorbed per Cubic Foot of Rock.	Coefficient of Wear.	Percentage of Wear.	Cementing Value.	Used on State Highway.
Paxton, .	Field stone (erratics),	234	-	-	8.48	4.72	8	1897 lay-out.
Paxton, .	Field stone (erratics),	280	-	-	5.96	7.60	-	1898 lay-out.
Phillipston, .	Field stone (erratics),	282	-	-	4.86	8.22	-	
Pittsfield, .	Limestone,	102	170.63	.25	9.88	4.26	-	
Pittsfield, .	Biotite schist,	69	176.88	.17	9.77	4.09	-	
Plainfield, Conn.,	Trap,	206	185.63	.21	22.23	1.80	-	
Plymouth, .	Field stone (erratics)	110	-	-	10.10	3.96	-	
Plymouth, .	Field stone (erratics),	294	-	-	10.28	3.89	-	
Plymouth, .	Field stone (erratics),	331	-	-	12.88	3.23	-	
Princeton, .	Field stone (erratics),	208	-	-	10.47	3.81	-	1897-98 lay-out.
Providence, .	Grit (carboniferous?),	36	-	-	10.02	3.99	23	1897 lay-out.
Quincy, .	Granite,	17	-	-	10.16	3.94	-	
Quincy, .	Diabase porphyry (trap),	18	183.75	-	16.21	2.63	-	
Quincy, .	Felsite,	72	174.38	.31	19.91	2.01	17	
Quincy, .	Diabase (trap),	230	193.75	-	25.56	1.56	-	
Quincy, .	-	278	-	-	15.03	2.66	-	
Quincy, .	Sandstone,	299	-	-	23.99	1.71	-	
Quincy, .	-	300	-	-	6.54	7.22	-	
Quincy, .	Mixed stone,	301	-	-	8.87	10.33	-	
Rehoboth, .	Field stone (erratics),	224	-	-	11.96	3.34	27	1896 lay-out.
Revere, .	Felsite porphyry,	3	166.88	.09	13.21	3.03	-	
Revere, .	Felsite,	124	165.00	.05	15.21	2.63	25	
Rockland Lake, N. Y.,	Diabase, coarse (trap),	95	182.50	.18	17.79	2.25	13	
Rockport, .	Granite,	34	163.75	.10	12.57	3.18	-	

	Limestone,	.	. .	.	.	.	53	176.25	-	8.26	4.85	10
Rockport, Me.,	Limestone,	.	.	.	.	.	54	-	-	9.00	4.45	-
" " "	" " "	.	.	.	.	.	55	166.88	.12	14.60	2.74	-
" " "	" " "	.	.	.	.	.	123	176.25	.08	9.68	4.17	16
" " "	Schist,	.	.	.	.	.	233	185.00	.38	16.97	2.96	22
" " "	Trap,	.	.	.	.	.	248	-	.08	19.44	2.06	16
" " "	Hornblende granite,	.	.	.	.	.	285	185.00	.08	16.46	2.43	-
" " "	Gneiss,	.	.	.	.	.	192	-	-	23.02	1.73	-
" " "	Felsite (brecciated),	.	.	.	.	.	97	163.75	.26	12.32	3.25	101
" " "	Angite diorite (trap),	.	.	.	.	.	1	174.38	-	15.55	2.57	-
" " "	Diorite (trap),	.	.	.	.	.	115	183.75	-	14.34	2.79	-
" " "	Trap,	.	.	.	.	.	312	-	-	8.92	4.48	-
" " "	Trap,	.	.	.	.	.	312A	-	-	12.04	3.32	-
" " "	Trap,	.	.	.	.	.	315	180.63	.22	12.82	3.12	-
" " "	Camptonite,	.	.	.	.	.	33	175.00	.22	16.76	2.39	-
" " "	Field stone (erratics),	.	.	.	.	.	200	-	-	11.62	3.47	29 1897 lay-out.
" " "	Diorite (trap),	.	.	.	.	.	25	187.50	.17	16.02	2.50	-
" " "	Diorite (trap),	.	.	.	.	.	22	186.25	.13	16.08	2.49	-
" " "	Diorite (trap),	.	.	.	.	.	28	190.00	.12	18.25	2.19	-
" " "	Diorite (trap),	.	.	.	.	.	15	173.75	.27	8.99	4.45	-
" " "	Granite,	.	.	.	.	.	32	186.75	.12	21.22	1.89	-
" " "	Mixed stone,	.	.	.	.	.	178	-	-	13.48	2.97	19 1896 lay-out.
" " "	Field stone (erratics),	.	.	.	.	.	213	-	-	12.32	3.25	24 1897 lay-out.
" " "	Field stone (erratics),	.	.	.	.	.	292	-	-	11.33	3.53	- 1898 lay-out.
" " "	Field stone (erratics),	.	.	.	.	.	175	-	-	11.88	3.37	13 out. 1895 and 1896 lay-
" " "	Field stone (erratics),	.	.	.	.	.	216	-	-	11.53	3.47	20 1897 lay-out.
" " "	Mixed stone,	.	.	.	.	.	321	-	-	8.01	4.54	- 1899 lay-out.
" " "	Slate (Cambrian?),	.	.	.	.	.	108	-	-	8.48	4.72	-
" " "	Diorite (trap),	.	.	.	.	.	19	176.88	.03	9.28	4.31	-
" " "	Hornblende syenite,	.	.	.	.	.	83	184.38	.12	19.77	2.07	- 1897 lay-out.
" " "	Hornblende syenite,	.	.	.	.	.	265	186.25	.14	17.09	2.34	11

TABLE I. — *Concluded.*

LOCALITY OF STONE.	Name of Stone.	Number of Spec- imens.	Weight of a Cubic Foot of a Stone (Pounds).	Pounds of Water Absorbed per Cubic Foot of Block.	Coefficient of Wear.	Percentage of Wear.	Comminuting Value.	Used on State Highway.
St. John, N. B., Canada,	-	308	170.63	.15	13.79	2.90	-	
St. John, N. B., Canada,	-	309	171.25	.16	10.41	3.84	-	
St. John, N. B., Canada,	-	310	176.25	.05	14.59	2.74	-	
St. John, N. B., Canada,	-	311	-	-	11.86	3.52	-	
Sudbury,	Field stone (erratics),	328	-	-	12.46	3.21	-	1898 lay-out.
Taunton,	Field stone (erratics),	291	-	-	11.66	3.43	-	1898 lay-out.
Taunton,	Field stone (erratics),	317	-	-	10.75	3.72	-	1899 lay-out.
Tisbury,	Field stone (erratics),	109	-	-	8.88	4.51	-	
Tomkin's Cove, N. Y.,	Limestone (siliceous),	127	176.88	.12	6.31	6.34	-	
Tomkin's Cove, N. Y.,	Limestone (siliceous),	45	-	-	7.84	5.10	-	
Uxbridge,	Hornblende granite,	63	188.75	.18	12.62	3.17	10	
Uxbridge,	Field stone (erratics),	289	-	-	10.44	3.83	9	1897 lay-out.
Walpole,	Conglomerate, . . .	70	-	-	11.57	3.46	12	1895 lay-out.
Walpole,	Field stone (erratics),	229	-	-	16.47	2.48	27	1897 lay-out.
Walpole,	Field stone (erratics),	276	-	-	14.28	3.80	-	1898 lay-out.
Waltham,	Granite,	4	163.75	.23	12.16	3.29	7	
Waltham,	Trap,	318	-	-	16.00	2.50	-	
Ware,	Diabase (trap), . .	64	186.88	.16	28.31	1.72	-	
Wareham,	Field stone (erratics),	257	-	-	6.80	6.87	-	
Warren, R. I.,	Field stone,	193	-	-	11.88	3.37	28	
Warwick, R. I., . . .	Field stone,	190	-	-	10.71	3.72	18	
Watertown,	Mixed stone,	183	-	-	13.15	3.29	20	
Watertown,	Field stone (erratics),	174	-	-	16.74	2.89	8	1895-96 lay-out.
Watertown,	Diabase (trap), . .	96	176.25	.43	13.70	2.92	-	

West Auburn,	.	.	.	.	114	168.13	.11	12.01	3.33	17	1897 lay-out.
Westminster,	.	.	.	.	199	-	-	8.34	4.80	-	
Westminster,	.	.	.	.	290	-	-	5.74	6.96	-	
Weston,	.	.	.	.	305	-	-	17.69	2.26	-	
Weston,	.	.	.	.	306	187.25	-	17.09	2.34	-	
Weston, /	.	.	.	.	307	188.75	-	18.51	2.16	-	
Weston,	.	.	.	.	313	-	-	16.66	2.40	-	
West Newbury,	.	.	.	.	186	-	-	10.11	3.95	14	1896 lay-out.
West Newbury,	.	.	.	.	228	-	-	13.27	3.01	15	1897 lay-out.
Westport,	.	.	.	.	122	-	-	14.18	2.82	29	1897 lay-out.
Westport,	.	.	.	.	81	168.13	.40	14.20	2.82	21	
Westport,	.	.	.	.	262	-	-	11.43	3.50	13	1898 lay-out.
West Springfield,	.	.	.	.	12	175.63	.10	15.60	2.56	-	
West Springfield,	.	.	.	.	67	184.38	.04	22.14	1.81	17	
West Springfield,	.	.	.	.	91	185.00	-	24.99	1.60	38	
West Springfield,	.	.	.	.	98	185.63	.18	21.60	1.85	-	
West Tisbury,	.	.	.	.	175	-	-	8.40	4.76	10	1896 lay-out.
West Tisbury,	.	.	.	.	198	-	-	6.76	5.91	7	1897 lay-out.
Weymouth,	.	.	.	.	92	-	-	14.52	2.75	16	
Whitman,	.	.	.	.	105	-	-	5.93	6.75	-	
Williamstown,	.	.	.	.	273	-	-	11.66	3.43	-	1898 lay-out.
Williamsburg,	.	.	.	.	316	-	-	6.45	6.20	-	1898 lay-out.
Wilmington, N. J.,	.	.	.	.	250	185.63	.11	19.64	2.04	53	
Winchester,	.	.	.	.	304	-	-	10.15	3.94	-	
Worcester,	.	.	.	.	184	-	-	11.83	3.38	46	1896 lay-out.
Worcester,	.	.	.	.	212	-	-	10.46	3.82	32	1897 lay-out.
Worcester,	.	.	.	.	263	-	-	9.12	4.38	-	Worcester-Holden, 1897 lay-out.
Worcester,	.	.	.	.	266	-	-	8.62	4.64	-	
Wrentham,	.	.	.	.	296	-	-	12.18	3.28	24	1897 lay-out.
Wrentham,	.	.	.	.	293	-	-	11.33	3.53	-	1898 lay-out.
Yarmouth,	.	.	.	.	171	-	-	11.99	3.34	28	1896 lay-out.
Yarmouth,	.	.	.	.	237	-	-	16.81	2.33	28	1897 lay-out.

APPENDIX C.

TABLE SHOWING TOWNS AND CITIES IN WHICH WORK HAS BEEN DONE DURING THE YEAR 1899,
THE RESIDENT ENGINEERS ON SUCH WORK, TOGETHER WITH DATES OF BEGINNING AND
ENDING.

TOWN OR CITY.	County.	Lay-out.	Resident Engineer.	Date of Contract.	Date of Beginning.	Date of Ending.
Acton,	Middlesex,	1899	Holden, H. C.,	Oct. 5, 1899,	1899.	1899.
Amesbury,	Essex,	1899	Merrill, G. A.,	Nov. 23, 1899,	Oct. 25,	Dec. 30.
Andover,	Essex,	1899	Holden, H. C.,	July 20, 1899,	Dec. 18,	Dec. 30.
Ashby,	Middlesex,	1898	Brown, C. L.,	Aug. 11, 1898,	July 31,	Sept. 28.
Ashby,	Middlesex,	1899	Moebis, J. J.,	July 28, 1899,	Aug. 16,	May 22.
Ashby,	Middlesex,	1899	Winslow, D. H.,	July 28, 1899,	Aug. 17,	Oct. 12.
Ashby,	Middlesex,	1899	Packard, S. G.,	July 28, 1899,	Oct. 24,	Nov. 11.
Ashfield,	Franklin,	1898	Proctor, L. J.,	Aug. 11, 1898,	Nov. 13,	Dec. 12.
Ashfield,	Franklin,	1898	Proctor, L. J.,	Aug. 11, 1898,	Jan. 1,	Feb. 4.
Ashfield,	Franklin,	1898	Proctor, L. J.,	Aug. 24, 1899,	Mar. 15,	June 3.
Auburn,	Worcester,	1899	Warren, H. E.,	Aug. 22, 1898,	Oct. 2,	Nov. 15.
Auburn,	Worcester,	1899	Power, E. P.,	July 28, 1899,	April 17,	Nov. 13.
Barnstable,	Barnstable,	1899	Gray, A. W.,	Aug. 8, 1899,	Aug. 22,	Nov. 11.
Barre,	Worcester,	1899	Cutter, F. P.,	Aug. 24, 1899,	Aug. 30,	Oct. 20.
Blackstone,	Worcester,	1899	Brine, L. R.,	Sept. 14, 1899,	Sept. 26,	Dec. 5.
Bourne,	Barnstable,	1898	Ruggles, E. F.,	Sept. 8, 1898,	Jan. 1,	Jan. 28.
Boxborough,	Middlesex,	1899	Holden, H. C.,	Sept. 14, 1899,	May 1,	May 14.
					Oct. 6,	Nov. 26.

Brimfield,	Hampden,	1899	Palmer, J. E.,	Aug. 10, 1899,	Aug. 21,	Dec. 9.
Brockton,	Plymouth,	1898	Cutter, F. P.,	Aug. 25, 1898,	April 10,	April 30.
Brockton,	Plymouth,	1899	Parsons, S. A.,	July 20, 1899,	Aug. 8,	Nov. 18.
Brookfield,	Worcester,	1898	Power, E. P.,	Aug. 18, 1898,	May 8,	June 8.
Buckland,	Franklin,	1898	Parsons, S. A.,	Aug. 18, 1898,	Jan. 1,	Mar. 18.
Buckland,	Franklin,	1898	Cutter, F. P.,	Aug. 18, 1898,	May 3,	June 5.
Buckland,	Franklin,	1899	Proctor, L. J.,	Oct. 5, 1899,	Oct. 19,	Dec. 18.
Charlemont,	Franklin,	1898	Proctor, L. J.,	July 7, 1898,	Aug. 6,	Sept. 4.
Charlemont (bridge),	Franklin,	1898	Crosby, W. W.,	Nov. 17, 1898,	Mar. 6,	July 26.
Charlemont,	Franklin,	1899	Proctor, L. J.,	Aug. 31, 1899,	Sept. 5,	Sept. 30.
Chatham (1),	Barnstable,	1899	Brine, L. R.,	May 18, 1899,	June 2,	July 15.
Chatham (2),	Barnstable,	1899	Brine, L. R.,	June 26, 1899,	July 17,	Sept. 7.
Chelmsford,	Middlesex,	1898	Knowlton, C. F.,	Oct. 13, 1898,	April 12,	June 24.
Chelmsford,	Middlesex,	1899	Knowlton, C. F.,	Oct. 13, 1898,	June 5,	June 24.
Cheshire,	Berkshire,	1899	Farnham, A. B.,	Oct. 5, 1899,	Oct. 24,	Dec. 30.
Chester,	Hampden,	1898	Everett, P. H.,	Sept. 14, 1899,	Oct. 3,	Nov. 28.
Chicopee,	Hampden,	1899	Gerry, L. L.,	Nov. 17, 1898,	April 20,	July 3.
Chicopee,	Hampden,	1899	Gerry, L. L.,	Nov. 17, 1898,	June 5,	July 3.
Cohasset,	Norfolk,	1899	Norton, C. H.,	Aug. 3, 1899,	Sept. 5,	Dec. 2.
Colrain,	Franklin,	1898	Cutter, F. P.,	Sept. 1, 1898,	May 8,	Aug. 5.
Colrain,	Franklin,	1898	Proctor, L. J.,	Sept. 1, 1898,	June 5,	Aug. 5.
Dartmouth,	Bristol,	1898	Warren, H. E.,	June 1, 1899,	June 16,	Sept. 26.
Dartmouth,	Bristol,	1899	Warren, H. E.,	June 1, 1899,	June 16,	Sept. 26.
Duxbury,	Plymouth,	1899	Wilbur, N. B.,	Sept. 21, 1899,	Oct. 3,	Nov. 25.
Edgartown,	Dukes,	1899	Crowell, J. H.,	Oct. 19, 1899,	Nov. 11,	Dec. 30.
Erving,	Franklin,	1898	Packard, S. G.,	Oct. 27, 1898,	Mar. 16,	April 18.
Erving,	Franklin,	1898	Grimes, M. W.,	July 6, 1899,	April 19,	June 6.
Erving,	Franklin,	1899	Phillips, H. D.,	Sept. 14, 1899,	July 17,	Sept. 15.
Gardner,	Worcester,	1899	Winslow, D. H.,	July 6, 1899,	Sept. 28,	Dec. 16.
Gardner,	Worcester,	1898	Ewell, W. W.,	July 6, 1899,	July 18,	Sept. 11.
					July 21,	Sept. 1.

TABLE SHOWING TOWNS AND CITIES IN WHICH WORK HAS BEEN DONE, ETC. — Continued.

TOWN OR CITY.	County.	Lay-out.	Resident Engineer.	Date of Contract.	Date of Beginning.	Date of Ending.
Gloucester,	Essex,	1898	Dadley, A. D.,	Mar. 17, 1898,	1899.	1899.
Grafton,	Worcester,	1899	Grimes, M. W.,	Aug. 31, 1899,	April 11,	May 30.
Great Barrington,	Berkshire,	1896	Everett, P. H.,	Aug. 3, 1899,	Sept. 22,	Dec. 5.
Greenfield,	Franklin,	1899	Gerry, L. L.,	June 1, 1899,	Aug. 17,	Oct. 7.
Hadley,	Hampshire,	1898	Gerry, L. L.,	Sept. 29, 1898,	July 13,	Nov. 23.
Hadley,	Hampshire,	1899	Gerry, L. L.,	Oct. 12, 1899,	Nov. 8,	Nov. 21.
Hamilton,	Essex,	1899	Raymond, C. A.,	Sept. 21, 1899,	Nov. 8,	Nov. 21.
Hancock,	Berkshire,	1899	Crosby, W. W.,	July 13, 1899,	Oct. 30,	Dec. 27.
Hancock,	Berkshire,	1899	Crosby, W. W.,	Sept. 26, 1899,	July 27,	Sept. 16.
Harwich,	Barnstable,	1899	Merrill, G. A.,	Aug. 3, 1899,	Sept. 28,	Dec. 15.
Haverhill,	Essex,	1899	Farnham, C. H.,	Oct. 12, 1899,	Sept. 13,	Nov. 9.
Leicester,	Worcester,	1898	Grover, O. L.,	May 12, 1898,	Nov. 2,	Dec. 30.
Leicester,	Worcester,	1899	Power, E. P.,	July 20, 1899,	May 26,	May 25.
Lenox,	Berkshire,	1899	Dadley, A. D.,	Aug. 3, 1899,	Oct. 5,	Dec. 13.
Lunenburg,	Worcester,	1898	Wheeler, W. B.,	Aug. 18, 1898,	May 22,	May 24.
Lunenburg,	Worcester,	1899	Winalow, G. R.,	Aug. 17, 1899,	Sept. 28,	Nov. 1.
Marion,	Plymouth,	1899	Colburn, E. N.,	Aug. 24, 1899,	Sept. 28,	Nov. 14.
Marlborough,	Middlesex,	1899	Gray, A. W.,	Aug. 24, 1899,	Nov. 12,	Dec. 30.
Marshfield,	Plymouth,	1898	Norton, C. H.,	Sept. 7, 1898,	Sept. 6,	Dec. 9.
Marshfield,	Plymouth,	1899	Ewell, W. W.,	Aug. 24, 1899,	May 4,	June 6.
Merrimac,	Essex,	1898	Palmer, J. E.,	Oct. 13, 1898,	Sept. 7,	Nov. 18.
Merrimac,	Essex,	1899	Farnham, C. H.,	-	May 23,	July 15.
Milton,	Norfolk,	1899	Merrill, G. A.,	Oct. 5, 1899,	Oct. 17,	Nov. 2.
Montague,	Franklin,	1899	Parsons, S. A.,	Dec. 14, 1899,	Nov. 2,	Dec. 15.
			Gerry, L. L.,		Nov. 7,	Dec. 30.
					Dec. 26,	

Nantucket.	.	.	.	.	.	1898	Southworth, A. L.,	Oct. 12, 1899,	Oct. 31,	Dec. 22.
Nantucket,	.	.	.	.	.	1899	Southworth, A. L.,	Oct. 12, 1899,	Oct. 31,	Dec. 22.
Newbury,	.	.	.	.	.	1899	Merrill, G. A.,	Oct. 12, 1899,	Nov. 27,	Dec. 22.
Newburyport,	.	.	.	.	.	1898	Palmer, J. E.,	Oct. 6, 1898,	April 22,	May 20.
Norfolk,	.	.	.	.	.	1895	Shaw, S.,	Dec. 22, 1898,	April 25,	June 2.
Northampton,	.	.	.	.	.	1898	Parsons, S. A.,	Sept. 29, 1898,	Oct. 11,	Dec. 14.
Northampton,	.	.	.	.	.	1899	Gerry, L. L.,	Aug. 17, 1899,	June 5,	July 22.
North Attleborough,	.	.	.	.	.	1899	Farnham, C. H.,	Aug. 24, 1899,	Sept. 6,	Oct. 28.
Northborough,	.	.	.	.	.	1898	Welton, C. A.,	Sept. 22, 1898,	July 13,	Sept. 16.
North Reading,	.	.	.	.	.	1898	Holden, H. C.,	Oct. 13, 1899,	May 22,	July 28.
Norwood,	.	.	.	.	.	1899	Shaw, S.,	May 18, 1899,	Aug. 7,	Oct. 26.
Norwood,	.	.	.	.	.	1899	Shaw, S.,	May 18, 1899,	Nov. 7,	Dec. 30.
Orange,	.	.	.	.	.	1897	Dadley, A. D.,	July 20, 1899,	July 20,	Aug. 1.
Palmer,	.	.	.	.	.	1899	Brown, C. L.,	Oct. 5, 1899,	Oct. 17,	Dec. 5.
Phillipston,	.	.	.	.	.	1899	Stuart, F. M.,	Sept. 16, 1898,	May 27,	June 6.
Pittsfield,	.	.	.	.	.	1898	Litchfield, S.,	Sept. 8, 1898,	May 20,	June 6.
Plymouth,	.	.	.	.	.	1897	Warren, H. E.,	July 6, 1899,	Sept. 28,	Nov. 25.
Reading,	.	.	.	.	.	1899	Holden, H. C.,	Sept. 21, 1899,	Sept. 28,	Oct. 4.
Reading,	.	.	.	.	.	1899	Caldwell, F. W.,	Sept. 21, 1899,	Oct. 4,	Dec. 22.
Rehoboth,	.	.	.	.	.	1899	Nichols, E. J.,	Aug. 24, 1899,	Sept. 25,	Dec. 7.
Revere,	.	.	.	.	.	1897-8	Nichols, E. J.,	April 7, 1898,	Jan. 1,	Feb. 18.
Revere,	.	.	.	.	.	1897-8	Farnham, A. B.,	April 7, 1898,	April 20,	April 29.
Revere,	.	.	.	.	.	1897-8	Holden, H. C.,	April 7, 1898,	Mar. 27,	April 7.
Revere,	.	.	.	.	.	1899	Badger, W. O.,	Oct. 19, 1899,	{ Oct. 23,	Nov. 28.
Revere,	.	.	.	.	.	1899	Ruggles, E. F.,	Sept. 29, 1898,	Nov. 23,	Dec. 30.
Richmond,	.	.	.	.	.	1898	Farnham, A. B.,	Aug. 3, 1899,	May 6,	June 6.
Richmond,	.	.	.	.	.	1899	Joyner, F. H.,	Aug. 3, 1899,	Aug. 17,	Sept. 5.
Richmond,	.	.	.	.	.	1899	Buckley, G. D.,	May 12, 1898,	Sept. 5,	Sept. 30.
Russell (1),	.	.	.	.	.	1898	Southworth, A. L.,	Sept. 29, 1898,	April 24,	Oct. 13.
Russell (2),	.	.	.	.	.	1898	Southworth, A. L.,	Aug. 10, 1899,	April 25,	Oct. 27.
Russell,	.	.	.	.	.	1899	Southworth, A. L.,	Aug. 10, 1899,	Aug. 15,	Oct. 27.

TABLE SHOWING TOWNS AND CITIES IN WHICH WORK HAS BEEN DONE, ETC. — *Concluded.*

TOWN OR CITY.	County.	Lay-out.	Resident Engineer.	Date of Contract.	Date of Beginning.	Date of Ending.
Sandwich,	Barnstable,	1898	Crosby, W. W.,	Sept. 22, 1898,	1899. Jan. 1,	1899. Feb. 16.
Sandwich,	Barnstable,	1898	Ruggles, E. F.,	Sept. 22, 1899,	Feb. 20,	June 23.
Saugus,	Essex,	1898	Badger, W. O.,	Oct. 19, 1899,	Oct. 23,	Nov. 23.
Saugus,	Essex,	1898	Ruggles, E. F.,	Oct. 19, 1899,	Nov. 23,	Dec. 30.
Shrewsbury,	Worcester,	1898	Welton, C. A.,	Aug. 24, 1899,	Sept. 13,	Oct. 1.
Shrewsbury,	Worcester,	1899	Welton, C. A.,	Aug. 24, 1899,	Sept. 13,	Dec. 18.
Somerset,	Bristol,	1899	Litchfield, S.,	July 20, 1899,	Aug. 12,	Nov. 4.
South Hadley,	Hampshire,	1898	Litchfield, S.,	Oct. 10, 1898,	April 27,	May 10.
South Hadley,	Hampshire,	1899	Cutter, F. P.,	Oct. 5, 1899,	Oct. 21,	Dec. 16.
Spencer,	Worcester,	1897	Power, E. P.,	Sept. 14, 1899,	Nov. 21,	Dec. 30.
Sudbury,	Middlesex,	1898	Winslow, D. H.,	Oct. 20, 1898,	April 10,	June 27.
Sutton,	Worcester,	1899	Stuart, F. M.,	Aug. 10, 1899,	Sept. 13,	Dec. 6.
Sutton,	Worcester,	1899	Grimes, M. W.,	Aug. 10, 1899,	Dec. 6,	Dec. 12.
Taunton,	Bristol,	1899	Grover, O. L.,	July 28, 1899,	Aug. 17,	Oct. 5.
Templeton,	Worcester,	1899	Winslow, D. H.,	June 22, 1899,	June 29,	Sept. 9.
Townsend,	Middlesex,	1898	Parsons, S. A.,	Sept. 15, 1898,	April 13,	May 30.
Townsend,	Middlesex,	1899	Parsons, S. A.,	Sept. 15, 1898,	May 10,	May 30.
Townsend,	Middlesex,	1899	Gray, A. W.,	Sept. 15, 1898,	July 24,	Aug. 9.
Townsend (bridge),	Middlesex,	1899	Parsons, S. A.,	Mar. 10, 1899,	Mar. 29,	May 23.
Uxbridge,	Worcester,	1897	Warren, H. E.,	Sept. 2, 1897,	May 26,	May 26.
Uxbridge,	Worcester,	1898	Warren, H. E.,	Sept. 15, 1898,	May 11,	May 24.
Walpole,	Norfolk,	1898	Holden, H. C.,	Sept. 29, 1898,	April 11,	May 23.
Ware,	Hampshire,	1899	Winslow, G. R.,	Oct. 5, 1899,	Nov. 1,	Nov. 30.
Warren,	Worcester,	1898	Power, E. P.,	Aug. 11, 1898,	April 26,	May 3.
West Boylston,	Worcester,	1897	Welton, C. A.,	Oct. 21, 1897,	May 8,	June 15.
West Boylston,	Worcester,	1898	Welton, C. A.,	Sept. 15, 1898,	April 13,	April 29.

West Brookfield (East),	.	Worcester,	.	1899	Grover, O. L.,	.	Sept. 7, 1899,	Oct. 11,	Dec. 13.
West Brookfield (West),	.	Worcester,	.	1899	Winslow, G. R.,	.	Oct. 5, 1899,	Nov. 1,	Nov. 30.
Westfield (1),	.	Hampden,	.	1899	Farnham, A. B.,	.	May 26, 1899,	June 6,	June 23.
Westfield (2),	.	Hampden,	.	1899	Farnham, A. B.,	.	Aug. 8, 1899,	Aug. 11,	Oct. 14.
Westminster,	.	Worcester,	.	1898	Winslow, D. H.,	.	Sept. 8, 1898,	Nov. 2,	Nov. 11.
Westminster,	.	Worcester,	.	1899	Winslow, D. H.,	.	Sept. 7, 1899,	Sept. 12,	Nov. 11.
Weston,	.	Middlesex,	.	1898-9	Knowlton, C. F.,	.	July 28, 1899,	Aug. 14,	Nov. 14.
Weston,	.	Middlesex,	.	1898-9	Raymond, C. A.,	.	July 28, 1899,	Aug. 31,	Oct. 28.
Weston,	.	Norfolk,	.	1899	Shaw, S.,	.	Sept. 21, 1899,	Nov. 1,	Dec. 30.
Westwood,	.	Hampshire,	.	1898	Ruggles, E. F.,	.	April 14, 1898,	June 20,	Aug. 23.
Williamsburg,	.	Hampshire,	.	1898	Crowell, J. H.,	.	July 20, 1899,	Sept. 7,	Nov. 2.
Williamsburg,	.	Hampshire,	.	1899	Ruggles, E. F.,	.	Aug. 31, 1899,	Sept. 18,	Dec. 1.
Winchester,	.	Middlesex,	.	1898	Shaw, S.,	.	Aug. 11, 1898,	April 6,	June 3.
Wrentham,	.	Norfolk,	.	1899	Merrill, D. W.,	.	Aug. 31, 1899,	Oct. 2,	Nov. 6.
Wrentham,	.	Norfolk,	.	1899	Shaw, S.,	.	Aug. 31, 1899,	Nov. 9,	Dec. 23.

APPENDIX D.

SHOWING CONTRACT PRICES ON

	TOWN OR CITY.	Number of Contract.	Contractor.	EXCAVATION.			RUBBLE MASONRY.		Gravel (Cubic Yard).
				All Kinds (Cubic Yard).	Borrow (Cubic Yard).	Ledge (Cubic Yard).	Dry (Cubic Yard).	Cement (Cubic Yard).	
1	Acton, . . .	416	Adams & Daw, . .	\$0 30	\$0 35	\$2 00	\$4 00	\$8 00	\$0 50
2	Amesbury, . .	431	White & Gaffey, . .	43	45	2 00	4 00	8 00	50
3	Andover, . . .	368	Town, . . .	30	-	1 75	4 00	8 00	50
4	Ashby, . . .	374	Town, . . .	30	30	1 75	3 50	7 00	50
5	Ashfield, . . .	392	David T. Perry, . .	-	-	-	-	-	1 30
6	Auburn, . . .	375	Town, . . .	35	35	1 75	4 00	8 00	50
7	Barnstable, . .	378	Asa Goddard, . . .	30	35	2 00	5 00	8 00	1 00
8	Barre, . . .	398	J. S. Lane & Son, . .	35	40	1 50	4 00	8 00	60
9	Blackstone, . .	406	J. J. Welch & Co., .	30	50	1 75	5 00	10 50	60
10	Boxborough, . .	407	Town, . . .	30	30	1 75	4 00	8 00	50
11	Brimfield, . . .	385	Andrew Carberry, . .	10 1	-	1 75	3 75	6 00	65
12	Brookton, . . .	369	City, . . .	35	-	1 75	4 00	9 00 12 00	50
13	Buckland, . . .	417	Town, . . .	30	30	1 75	4 00	8 00	50
14	Charlemont, . .	400	Town, . . .	30	30	1 75	4 00	8 00	50
15	Chatham, . . .	387	Town, . . .	20	13 30	1 75	6 00	10 00	-
16	Chatham, . . .	363	Town, . . .	20	13 30	1 75	6 00	10 00	-
17	Cheshire, . . .	418	Polcaro & Ferranti, .	23	-	1 10	5 00	8 50	4 62
18	Chester, . . .	408	W. N. Flynt Granite Co.	40	40	2 00	4 00	8 00	-
19	Cohasset, . . .	379	Town, . . .	45	45	1 75	4 00	8 00	75
20	Dartmouth, . . .	380	Town, . . .	40	40	1 75	4 00	7 00	60
21	Duxbury, . . .	411	J. S. Lane & Son, . .	40	-	2 00	5 00	8 00	50

4 Screened.

6 Cement masonry in bridge.

13 Clay.

APPENDIX D.

STATE ROADS DURING 1899.

Telford (Square Yard).	Shaping (Square Yard).	BROKEN STONE.		PIPE CULVERTS.				Fencing (Linear Foot).	Side Drains (Linear Foot).	Bounds (Each).	Catch-basins (Each).	
		Local (Ton).	Trap (Ton).	Twelve-inch Clay (Linear Foot).	Twenty-four-inch Clay (Linear Foot).	Twelve-inch Iron (Linear Foot).	Other Kinds (Linear Foot).					
-	\$0 02	-	\$1 90	\$0 00	¹ \$0 85	\$1 75	² \$2 85/ ³ \$3 00	\$0 15	\$0 35	\$1 40	-	1
-	02	\$1 50	-	08	¹ 1 05	-	² 2 40	22	42	1 75	-	2
\$0 30	02	1 40	-	00	Cost	-	-	15	35	1 50	-	3
30	02	1 55	-	00	¹ Cost	-	-	15	35	1 50	-	4
-	-	-	-	-	-	-	-	-	-	-	-	5
30	02	-	1 90	00	-	-	-	15	35	1 40	-	6
35	02½	1 60	-	70	⁵ 60	2 50	-	25	35	1 50	\$30 00	7
-	08	-	1 75	70	¹¹ 1 25	-	-	25	40	1 50	25 00	8
-	08	-	1 70	65	2 25	-	¹¹ 1 30	20	40	1 50	20 00	9
30	02	1 41	-	00	-	-	-	15	35	1 50	-	10
-	-	-	-	65	1 85	-	-	20	25	2 50	-	11
30	02	1 25	⁹ Cost ¹⁰ Cost	00	⁶ Cost	Cost	⁷ Cost	15	35	1 50	Cost	12
35	02	-	1 90	00	-	-	-	15	35	1 25	Cost	13
35	02	¹¹ 1 90	2 10	00	-	-	-	15	35	1 30	Cost	14
30	02	2 00	-	00	¹² 45 ¹³ 85	-	-	17	50	1 00	Cost	15
30	02	2 00	-	00	¹² 85	-	-	17	50	1 00	Cost	16
-	08½	-	1 78	02	-	-	-	20	38	1 60	-	17
-	08	-	1 75	75	¹¹ 1 25	-	-	25	40	2 00	-	18
35	02	1 35	-	00	-	-	-	15	40	1 30	Cost	19
30	02	1 40	-	00	¹² 40 ¹⁴ 75	-	-	15	35	1 50	Cost	20
-	08	1 60	-	¹⁵ 60	-	2 00	-	20	40	1 50	25 00	21

¹ Eighteen inch clay pipe.⁵ Ten inch clay pipe.⁹ Superstructure of bridge.¹³ Eight inch clay pipe.³ Sixteen inch iron pipe.⁶ Twenty inch clay pipe.¹⁰ Grouting.¹⁴ Fifteen inch clay pipe.⁸ Eighteen inch iron pipe.⁷ Thirty inch iron pipe.¹¹ Granite.

SHOWING CONTRACT PRICES ON

	TOWN OR CITY.	Number of Contract.	Contractor.	EXCAVATION.			RUBBLE MASONRY.		Gravel (Cubic Yard).
				All Kinds (Cubic Yard).	Borrow (Cubic Yard).	Ledge (Cubic Yard).	Dry (Cubic Yard).	Concrete (Cubic Yard).	
1	Edgartown, . .	428	Town,	\$0 25	\$0 25	\$1 75	\$5 00	\$10 00	\$1 00
2	Erving, . . .	364	White & Gaffey, .	30	-	2 50	3 00	7 00	11 00
3	Erving, . . .	409	Tuttle & Edgerly, .	40	-	2 00	4 50	8 00	11 25
4	Gardner, . . .	365	A. J. Wellington, .	-	-	-	-	-	-
5	Grafton, . . .	401	Town,	35	35	1 75	4 00	9 00	55
6	Great Barrington,	380	Town,	-	-	-	-	-	-
7	Greenfield, . .	361	Town,	45	80	1 75	4 00	8 00	50
8	Hadley, . . .	423	B. D. Pierce, Jr., Co.,	33	39	2 00	5 00	10 00	-
9	Hamilton, . . .	412	Town,	40	40	1 75	5 00	8 00	50
10	Hancock, . . .	367	Joseph D. Gennaro, .	26	-	90	5 00	9 00	11 25
11	Hancock, . . .	415	Polcaro & Ferranti, .	26	-	90	5 00	9 00	11 25
12	Harwich, . . .	381	Doane, Arey & Allen,	20	35	2 00	7 50	11 00	50
13	Haverhill, . .	424	David Hall, . . .	25	27½	1 00	5 00	6 50	-
14	Leicester, . .	370	Town,	35	40	1 75	5 00	10 00	1 20
15	Lenox, . . .	382	Asa Goddard, . . .	35	50	2 00	4 00	8 00	1 20
16	Lunenburg, . .	389	B. D. Pierce, Jr., Co.,	33	39	2 50	4 00	8 00	39
17	Marion, . . .	394	Town,	35	50	1 75	4 00	8 00	60
18	Marlborough, .	395	City,	35	-	1 75	4 00	9 00	60
19	Marshfield, . .	396	Arthur Mulvey, . .	40	40	2 00	4 00	7 00	40
20	Milton, . . .	419	J. S. Lane & Son, .	35	50	2 00	5 00	8 00	-
21	Montague, . .	482	Town,	25	25	1 75	5 00	10 00	65
22	Nantucket, . .	425	Gardner O. Luther, .	50	11 75	2 00	5 00	10 00	175
23	Newbury, . . .	426	Boston Paving Co., .	35	45	2 50	5 00	8 00	65
24	Northampton, .	390	City,	35	35	1 75	5 00	10 00	75
25	No. Attleborough,	397	Andrew Carberry, .	48	1 00	2 00	5 00	8 00	11 80
26	Norwood, . . .	358	Town,	40	50	1 75	4 00	7 00	60
27	Orange, . . .	371	Town,	30	-	1 75	4 00	7 00	60
28	Palmer, . . .	427	W. N. Flynt Granite Co.	40	40	2 00	4 50	8 00	60
29	Plymouth, . .	366	A. J. Wellington, .	50	-	-	-	-	-
30	Reading, . . .	413	White & Gaffey, .	40	-	2 00	4 50	8 00	50

¹ Screened.⁸ Wall excavation.¹¹ Clay.

STATE ROADS DURING 1899 — *Continued.*

Telford (Square Yard).	Shaping (Square Yard).	BROKEN STONE.		PIPE CULVERTS.				Fencing (Linear Foot).	Side Drains (Linear Foot).	Bounds (Each).	Catch-basins (Each).	
		Local (Ton).	Trap (Ton).	Twelve-inch Clay (Linear Foot).	Twenty-four-inch Clay (Linear Foot).	Twelve-inch Iron (Linear Foot).	Other Kinds (Linear Foot).					
\$0 50	\$0 02	\$2 25	-	\$0 65	-	-	-	-	\$0 45	\$1 25	-	1
50	-	-	-	60	\$1 50	-	-	\$0 20	40	2 00	\$25 00	2
-	-	-	-	50	1 50	-	-	15	30	1 50	30 00	3
-	-	-	\$2 30	-	-	-	-	-	-	-	-	4
35	02	-	1 90	60	Cost	-	³ Cost	15	35	1 40	-	5
-	-	-	2 00	-	-	-	-	-	-	-	-	6
30	02	-	1 10	60	⁴ Cost	-	-	15	35	1 25	Cost	7
-	03	-	1 85	60	-	-	-	20	35	1 50	50 00	8
35	02	1 60	-	60	⁵ Cost	-	-	15	35	1 50	⁷ Cost	9
-	-	-	-	60	⁶ Cost	-	-	17	40	5 00	-	10
-	-	-	-	60	⁷ 50	-	-	17	40	5 00	-	11
-	02½	2 25	-	65	⁸ 1 00	-	-	22	50	1 00	25 00	12
-	-	-	-	70	⁹ 85	-	-	22	32	1 50	30 00	13
35	02	1 30	-	60	¹⁰ 95	-	-	15	35	1 50	Cost	14
40	02½	1 20	2 50	70	¹¹ 1 10	-	-	25	40	2 00	30 00	15
35	03	1 38	2 05	65	-	-	-	20	35	1 50	50 00	16
30	02	1 30	-	60	¹² Cost	-	-	15	30	1 50	-	17
30	02	1 35	-	60	-	Cost	Cost	15	35	1 50	-	18
-	03	1 60	-	65	2 00	-	-	20	40	1 00	-	19
-	03	-	1 75	60	-	-	-	20	-	1 50	-	20
5	-	-	-	60	-	-	-	15	35	1 25	Cost	21
-	03	2 10	-	75	-	-	-	25	-	1 50	-	22
-	02	1 30	-	-	¹³ 50	\$2 00	¹⁴ 1 50	25	40	1 00	25 00	23
35	02	-	1 65	60	-	-	¹⁵ 3 00	15	40	1 50	-	24
-	-	-	-	75	-	-	¹⁶ 96	20	45	8 00	-	25
35	02	1 45	¹⁷ Cost	60	¹⁸ 40	-	-	15	35	1 50	¹⁹ Cost	26
35	02	-	2 05	60	-	-	-	15	35	1 50	-	27
-	03	-	1 75	75	²⁰ 1 00	-	-	25	50	2 00	-	28
-	02	1 50	-	-	²¹ 2 50	-	-	-	-	-	-	29
-	02½	1 50	-	60	²² 55	-	-	20	40	2 00	22 00	30

¹ Twenty-four inch iron pipe.² Eight inch clay pipe.³ Twenty inch clay pipe.⁴ Grouting.⁵ Eighteen inch clay pipe.⁶ Leaching basins.⁷ Eighteen inch iron pipe.⁸ Drop inlets.⁹ Ten inch clay pipe.¹⁰ Fifteen inch clay pipe.¹¹ Ten inch iron pipe.

SHOWING CONTRACT PRICES ON

	TOWN OR CITY.	Number of Contract.	Contractor.	EXCAVATION.			CUBIC YARDS.		Gravel (Cubic Yard).
				All Kinds (Cubic Yard).	Borrow (Cubic Yard).	Ledge (Cubic Yard).	Dry (Cubic Yard).	Cement (Cubic Yard).	
1	Edgartown, . . .	423	Town,	\$0 25	\$0 25	\$1 75	\$5 00	\$10 00	\$1 00
2	Erving,	364	White & Gaffey, . .	30	-	2 50	3 00	7 00	1 00
3	Erving,	400	Tuttle & Edgerly, . .	40	-	2 00	4 50	8 00	1 25
4	Gardner,	305	A. J. Wellington, . .	-	-	-	-	-	-
5	Grafton,	401	Town,	35	35	1 75	4 00	9 00	55
6	Great Barrington, .	380	Town,	-	-	-	-	-	-
7	Greenfield, . . .	361	Town,	45	30	1 75	4 00	8 00	50
8	Hadley,	423	B. D. Pierce, Jr., Co.,	33	39	2 00	5 00	10 00	-
9	Hamilton,	412	Town,	40	40	1 75	5 00	8 00	50
10	Hancock,	367	Joseph D. Gennaro, . .	26	-	90	5 00	9 00	1 25
11	Hancock,	415	Polcario & Ferranti, . .	26	-	90	5 00	9 00	1 25
12	Harwich,	381	Doane, Arey & Allen, . .	30	35	2 00	7 50	11 00	50
13	Haverhill,	424	David Hall,	25	27½	1 00	5 00	6 50	-
14	Leicester,	370	Town,	35	40	1 75	5 00	10 00	1 20
15	Lenox,	382	Asa Goddard,	35	50	2 00	4 00	8 00	1 20
16	Luzenburg,	380	B. D. Pierce, Jr., Co.,	33	39	2 50	4 00	8 00	30
17	Marion,	304	Town,	35	50	1 75	4 00	8 00	60
18	Marlborough, . . .	305	City,	35	-	1 75	4 00	9 00	60
19	Marshfield,	306	Arthur Mulvey,	40	40	2 00	4 00	7 00	40
20	Milton,	419	J. S. Lane & Son, . . .	35	50	2 00	5 00	8 00	-
21	Montague,	452	Town,	25	25	1 75	5 00	10 00	65
22	Nantucket,	425	Gardner O. Luther, . .	50	11 75	2 00	5 00	10 00	175
23	Newbury,	426	Boston Paving Co., . .	35	45	2 50	5 00	8 00	65
24	Northampton, . . .	300	City,	35	35	1 75	5 00	10 00	75
25	No. Attleborough, .	307	Andrew Carberry, . . .	48	1 00	2 00	5 00	8 00	1 80
26	Norwood,	358	Town,	40	50	1 75	4 00	7 00	60
27	Orange,	371	Town,	30	-	1 75	4 00	7 00	60
28	Palmer,	427	W. N. Flynt Granite Co.	40	40	2 00	4 50	8 00	60
29	Plymouth,	366	A. J. Wellington, . . .	50	-	-	-	-	-
30	Reading,	413	White & Gaffey, . . .	40	-	2 00	4 50	8 00	50

1 Screened.

2 Wall excavation.

11 Clay.

STATE ROADS DURING 1899 — *Continued.*

Telford (Square Yard).	Shaping (Square Yard).	BROKEN STONE.		PIPE CULVERTS.				Fencing (Linear Foot).	Side Drains (Linear Foot).	Bounds (Each).	Catch-basins (Each).	
		Local (Ton).	Trap (Ton).	Twelve-inch Clay (Linear Foot).	Twenty-four-inch Clay (Linear Foot).	Twelve-inch Iron (Linear Foot).	Other Kinds (Linear Foot).					
\$0 50	\$0 02	\$2 25	-	\$0 65	-	-	-	-	\$0 45	\$1 25	-	1
50	-	-	-	60	\$1 50	-	-	\$0 20	40	2 00	\$25 00	2
-	-	-	-	50	1 50	-	-	15	30	1 50	30 00	3
-	-	-	\$2 39	-	-	-	-	-	-	-	-	4
85	02	-	1 90	60	Cost	-	³ Cost	15	35	1 40	-	5
-	-	-	2 00	-	-	-	-	-	-	-	-	6
30	02	-	1 10	60	⁴ Cost	-	-	15	35	1 25	Cost	7
-	03	-	1 85	60	-	-	-	20	35	1 50	50 00	8
35	02	1 60	-	60	⁵ Cost	-	-	15	35	1 50	⁷ Cost	9
-	-	-	-	60	⁶ Cost	-	-	17	40	5 00	-	10
-	-	-	-	60	⁷ 5	-	-	17	40	5 00	-	11
-	02½	2 25	-	65	-	-	-	22	50	1 00	25 00	12
-	-	-	-	70	⁸ 55	-	-	22	32	1 50	30 00	13
35	02	1 30	-	60	⁹ 95	-	-	15	35	1 50	Cost	14
40	02½	1 20	2 50	70	1 10	-	-	25	40	2 00	30 00	15
35	03	1 38	2 05	65	-	-	-	20	35	1 50	50 00	16
30	02	1 30	-	60	¹⁰ Cost	-	-	15	30	1 50	-	17
30	02	1 35	-	60	-	Cost	Cost	15	35	1 50	-	18
-	03	1 60	-	65	2 00	-	-	20	40	1 00	-	19
-	03	-	1 75	60	-	-	-	20	-	1 50	-	20
5	-	-	-	60	-	-	-	15	35	1 25	Cost	21
-	03	2 10	-	75	-	-	-	25	-	1 50	-	22
-	02	1 30	-	-	¹¹ 50	\$2 00	¹² 1 50	25	40	1 00	25 00	23
35	02	-	1 65	60	-	-	-	15	40	1 50	-	24
-	-	-	-	75	-	-	¹³ 96	20	45	3 00	-	25
35	02	1 45	¹⁴ Cost	60	¹⁵ 40	-	-	15	35	1 50	¹⁶ Cost	26
35	02	-	2 05	60	-	-	-	15	35	1 50	-	27
-	03	-	1 75	75	¹⁷ 1 00	-	-	25	50	2 00	-	28
-	02	1 50	-	-	2 50	-	-	-	-	-	-	29
-	02½	1 50	-	60	¹⁸ 55	-	-	20	40	2 00	22 00	30

³ Twenty-four inch iron pipe.⁴ Eighteen inch clay pipe.⁵ Ten inch clay pipe.⁶ Eight inch clay pipe.⁷ Leaching basins.⁸ Fifteen inch clay pipe.⁹ Twenty inch clay pipe.¹⁰ Eighteen inch iron pipe.¹¹ Ten inch iron pipe.¹² Grouting.¹³ Drop inlets.

APPENDIX E.

LIST OF COMPLETED ROADS FINALLY APPROVED
DURING THE YEAR 1899, WITH DATES OF
APPROVAL.

CITY OR TOWN.	Year of Lay-out.	Number of Contract.	Contractor.	Date of Approval of Work done under Con- tract.
Ashby,	1897	197	Town,	Aug. 3, 1899.
Ashby,	1898	303	Town,	June 22, 1899.
Ashfield,	1898	296	J. D. Gennaro,	June 22, 1899.
Ashfield,	1898	304	Tuttle & Edgerly, . . .	Sept. 7, 1899.
Beverly,	1898	316	City,	June 9, 1899.
Brookton,	1897	216	City,	June 30, 1899.
Brookton,	1898	317	City,	June 30, 1899.
Brookfield,	1898	307	Town,	June 15, 1899.
Buckland,	1898	308	Town,	Dec. 20, 1899.
Charlemont,	Br. abut.	351	Jarvis Engineering Company,	Aug. 17, 1899.
Charlemont,	1899	400	Town,	Dec. 20, 1899.
Chatham,	1899	357	Town,	Oct. 19, 1899.
Chatham,	1899	363	Town,	Dec. 20, 1899.
Chicopee,	1897	235	City,	Aug. 17, 1899.
Chicopee,	1898	352	City,	Oct. 12, 1899.
Chicopee,	1899	352	City,	Oct. 12, 1899.
Colrain,	1898	318	Town,	Oct. 12, 1899.
Concord,	1898	319	Town,	June 30, 1899.
Gardner,	1897-8	365	A. J. Wellington, . . .	Nov. 23, 1899.
Gloucester,	1898	233	City,	June 15, 1899.
Great Barrington,	1897	255	Town,	July 6, 1899.
Hadley,	1898	336	A. J. Wellington, . . .	July 20, 1899.
Holden,	1898	300	Town,	Dec. 7, 1899.
Leicester,	1898	293	Town,	June 22, 1899.
Lexington,	1898	235	Town,	Feb. 16, 1899.

STATE ROADS DURING 1899 — *Concluded.*

Telford (Square Yard).	Shaping (Square Yard).	BROKEN STONE.		PIPE CULVERTS.				Fencing (Linear Foot).	Side Drains (Linear Foot).	Bounds (Each).	Catch-basins (Each).	
		Local (Ton).	Trap (Ton).	Twelve-inch Clay (Linear Foot).	Twenty-four-inch Clay (Linear Foot).	Twelve-inch Iron (Linear Foot).	Other Kinds (Linear Foot).					
\$0 30	\$0 02	\$1 45	-	\$0 60	-	-	-	\$0 15	\$0 35	\$1 50	-	1
\$1 00	02	-	\$1 35	-	-	-	-	15	-	1 50	-	2
35	-	-	-	60	-	-	-	15	-	1 50	Cost	3
35	-	-	-	60	\$2 00	-	-	15	35	1 25	-	4
{ 35	{ 02	1 57	-	60	-	Cost	-	15	35	1 75	-	5
{ 60	{ 02	1 45	-	60	-	-	-	15	35	1 50	-	6
35	02	1 45	-	60	-	-	-	15	35	1 50	-	6
-	03	-	1 85	70	-	-	-	15	30	1 50	\$10 00	7
35	02	1 40	-	60	-	-	-	15	35	1 50	-	8
35	02	1 52	-	60	-	-	-	15	35	1 50	-	9
-	03	1 60	-	70	-	-	-	30	45	2 00	-	10
35	02	-	2 00	65	-	-	-	25	40	1 50	25 00	11
-	-	-	-	-	-	-	-	-	-	-	-	12
-	03	-	2 00	90	-	-	-	15	35	2 00	10 00	13
-	03	-	1 80	70	2 00	-	-	20	50	1 50	-	14
-	03	-	1 85	-	-	\$1 25	\$3 25	25	45	1 50	-	15
80	02	-	1 20	60	-	-	-	15	30	1 25	-	16
35	02	-	1 40	60	{ Cost	-	-	15	35	1 50	-	17
-	03	1 80	-	70	{ Cost	-	-	25	45	1 50	20 00	18
11 60	-	1 60	-	70	{ 10 1 25	-	-	25	40	1 50	20 00	19
-	03	1 40	-	70	{ 12 40	2 80	{ 13 1 50	25	50	2 00	30 00	20
35	02	-	1 70	60	{ 14 60	-	{ 15 2 00	15	50	1 30	-	21
-	-	1 45	-	-	{ 16 1 00	-	-	-	-	-	-	22
30	02	90	-	60	{ Cost	Cost	15 Cost	12	25	1 25	Cost	23
30	02	1 60	-	60	-	Cost	-	15	35	1 25	Cost	24

⁸ Riprap.⁹ Twenty inch clay pipe.¹² Eight inch clay pipe.¹⁵ Ten inch iron pipe.⁵ Cobble gutters.¹⁰ Eighteen inch clay pipe.¹³ Eight inch iron pipe.¹⁶ Fifteen inch clay pipe.⁶ Twenty-four inch iron pipe.¹¹ Cobble-stone paving.¹⁴ Ten inch clay pipe.

LIST OF COMPLETED ROADS, ETC. — *Concluded.*

CITY OR TOWN.	Year of Lay-out.	Number of Contract.	Contractor.	Date of Approval of Work done under Con- tract.
Uxbridge,	1896	331	Pike & Hames,	Oct. 19, 1899.
Walpole,	1896	340	J. J. Falvey,	Aug. 24, 1899.
Warren,	1896	306	J. S. Lane & Son,	June 30, 1899.
West Boylston,	1897	374	O. H. Kelleher,	July 20, 1899.
West Boylston,	1896	332	Town,	Sept. 14, 1899.
Westfield,	1896	360	Town,	Oct. 12, 1899.
Westfield,	1896	360	Town,	Oct. 12, 1899.
Westminster,	1897	196	Town,	Aug. 3, 1899.
Westport,	1897	307	Town,	June 30, 1899.
Westport,	1896	289	A. J. Wellington,	June 30, 1899.
Weymouth,	1897	309	Town,	June 30, 1899.
Williamsburg,	1896	290	Town,	Sept. 7, 1899.
Williamstown,	1896	315	Town,	June 30, 1899.
Wrentham,	1896	306	Town,	Sept. 7, 1899.

APPENDIX F.

THE DISTRIBUTION OF STATE ROADS IN THE COMMONWEALTH.

For the information of the many interested in this question, the following is reprinted from the report of 1897:—

The selection of roadways which shall be rebuilt as State roads at the expense of the Commonwealth is naturally the most difficult problem with which the commission has to deal. The nature of that problem will be more readily understood after an examination of the map of the State, which forms a part of this report, on which is laid down, in addition to county and town boundaries, the roadways which the commission has been petitioned to take, and those which it has up to this date actually accepted as State roads, nearly all of the latter having been actually constructed.

Under the provisions of the law the commissioners are not permitted to control the expenditure of the appropriation entirely by their own judgment. They are restricted to two provisions, the wisdom of which they do not at all criticise, but which should always be kept in mind in considering the results of their labors. The first of these is that "all constructions of State roads shall be fairly apportioned among the different counties," and in this they have been guided in the main by the relative miles of roadway existing in the several counties. The second is the restriction growing out of the use of the petition. It was obviously the intention of the Legislature to limit the initiative of the Highway Commission in planning for the location of State ways. As is well known, the commission cannot of its own motion accept or reject any route; it has to await the petitions of the municipalities or the county commissioners. The only manner in which it can effect any satisfactory grouping of these petitions, so that continuous routes may come from the constructive work, is by rejecting the petitions which may come to it, or by counselling with the authorities having the right to petition in advance of their formal requests.

In order to keep the State roads from having a total lack of ultimate purpose in their relations to each other in the distribution of the Commonwealth, the commission has been compelled gradually, though not formally, to come to a state of mind as regards the selection of roads which are to be taken. In part this rather undetermined project is indicated by the distribution of the routes which have been accepted, as is shown on the accompanying map.* In part, though less distinctly, it is indicated by the direction of the petitions, the greater part of which have been submitted after more or less conference with the commission.

It appears to your commission that the time has now come when some statement, still necessarily tentative, shall be made which will set forth in a general way the views of the commission as to the policy to be followed by the Commonwealth in the construction of State roads. This statement is submitted in no sense as a hard-and-fast plan, but in order to set forth the direction in which the work of the commission is inevitably drifting; and we should hope that this statement may provoke criticism, and, if need be, modification of the action.

It seems, in the first place, clear that the most important of the many needs which are to be met by the construction of State roads is that which relates to the connection of centres of business in the Commonwealth with each other in so far as the business relations demand this connection. Thus, where two towns have a large exchange of relations, the way lying through other towns which profit little by the traffic, there is good reason why the State should take charge of the main connecting way.

Closely related to this is the case of a considerable number of smaller, less populous towns, surrounding a large city or centre of dense population, with which they have intimate business relations. It furnishes the market for their products, and the profit to the producer as well as the cost to the consumers is largely determined by the cost of local transportation. Even where facilities for transportation by rail exist, there is still much use of the public highway whenever it is in reasonably good condition. It is in evidence before the commission that many articles of produce, especially perishable and delicate fruits, are preferably sent many miles to the city markets in farm wagons, where shipping by rail would be both quicker and cheaper, on account of the better condition in which they may be delivered.

In making its selections among numerous petitions, the commission has endeavored to keep in mind the great advantages arising from easy connections between large centres of population and the sur-

* See end of report.

rounding agricultural areas ; for in so doing the demands of both urban and suburban populations are recognized and their mutual interests promoted.

Another class of cases arises, in which one or more towns lie remote from the rail or water ways, losing opportunities of advancement on account of this hindrance. These conditions are in some cases so grave that the average cost during the year of transporting a ton of freight from a village otherwise well placed for manufacturing to the business centres of the Commonwealth is greater than would be incurred in transporting the same burden from the central portion of the Mississippi valley to the city of Boston. In these cases, also, the commission feels impelled to better the traffic conditions by improving the way.

In yet other but not numerous cases, portions of the State adjacent to this Commonwealth have their natural business centres in some of our cities or towns, but the people thus residing beyond the bounds of the Commonwealth are deterred from seeking access to its markets by the difficulties of the way. In such instances it seems desirable that good roads should be provided to the bounds of the Commonwealth.

The conditions above mentioned may be regarded as of a local character. There remains yet another of such interests of a general nature to be provided for. These will be met by so grouping the State roads that they will in the end afford continuous routes through the Commonwealth, which may serve the interests of pleasure travel or the occasional distant carriage which would be done by ordinary wagons where the roads were good. These extended ways, including in general those which relate to driving for a distance of more than fifteen miles, are of greater importance to the interests of the Commonwealth than might at first sight appear. A considerable part of the present and much of the prospective value of real estate in the Commonwealth, as well as the traffic which takes place therein, is due to the incoming of people from the central and western parts of the country, who seek summer residences and family homes in the very attractive rural districts of the State. People who thus resort to the Commonwealth for recreation desire opportunities for driving such as would be afforded by a well-regulated system of State ways, which would be laid out and beautified with some reference to the natural and historic interests of the country. It is hardly necessary to say that the use of the bicycle for pleasure travel would also be thus accommodated.

Although the commissioners do not propose to build roads which relate only or even mainly to pleasure travel, they feel that the service which can be done by a system which relates to such travel is so

great and of such economic importance to the Commonwealth that it should always be kept in mind.

An examination of the map referred to above will reveal in some degree the groupings of highways up to this time, as indicated by petitions and by acceptance. A few rather long, continuous lines of State highway are apparently demanded at the present time, and their construction ought to be kept in view in the acceptance of petitions, but the commission must not allow itself to be too much influenced by an adjustment of petitions, which often stand only for local interest and activity. While there is often good reason for accepting one highway on account of local conditions, although it may not form a part of any general scheme, and another because it does fit into such a scheme, although of less local value than another which may be near by, there is often equally good reason for postponing action on a third because it is relatively of less *immediate* importance than either of the others.

The commissioners are of the opinion that nearly every mile of road thus far petitioned for should some time be built as a State highway; but it is clear that, as only a comparatively small number of miles can be completed annually, some selection must be made.

In choosing which shall be undertaken first, the commissioners must be governed by considerations of the broadest character, many of which will not be evident to those who necessarily think most of local interests. The order of presentation of petitions can have no influence, nor should it be inferred that, because a petition is not granted this year, it may not be next, or the year after. Outside of the limitations put upon them by the statute, the commissioners are bound to exercise their best judgment in all cases; and, while they are likely to be far from infallible, and welcome fair criticism, all who are unselfishly interested in the extension of this important system of State highway construction are likely to accept the judgment as the result of a comprehensive knowledge of the whole situation, growing out of the necessary consideration of the scheme as a whole.

APPENDIX G.

SHOWING THE ACTS AND RESOLVES UNDER
WHICH THE WORK OF THE COMMISSION
IS CARRIED ON.

[ACTS OF 1892, CHAPTER 338.]

AN ACT TO ESTABLISH A COMMISSION TO IMPROVE THE
HIGHWAYS OF THIS COMMONWEALTH.*Be it enacted, etc., as follows:*

SECTION 1. The governor with the advice and consent of the council shall, within thirty days from the passage of this act, appoint three persons, one of whom shall be a civil engineer, whose terms of office shall expire on the first Wednesday of February in the year eighteen hundred and ninety-three, to consider what legislation is necessary for the better construction and maintenance of the highways in this Commonwealth.

Commission to improve the highways of the Commonwealth to be appointed.

SECTION 2. The said commission shall forthwith proceed to investigate and consider the best and most practical method of construction and maintenance of highways, and the estimated costs of the various methods and systems; the establishment of state or county highways, with recommendations as to their construction and maintenance; routes and the approximate cost; also the geological formation so far as it relates to the material suitable and proper for road building. Said commission shall prepare suitable maps and plans on which shall be clearly drawn the various routes they recommend.

To recommend best methods of construction, etc.

SECTION 3. Said commission may establish rules and regulations for the conduct of its business and shall be provided with suitable quarters by the sergeant-at-arms in the state house or elsewhere. They may employ experts and all necessary clerical and other assistants, and may incur such reasonable expenses, including travelling

May establish rules and regulations.

To submit estimates of expenses to the governor and council.

Compensation.

Information to be furnished by county commissioners, etc.

To make report to the legislature.

Vacancy.

expenses, as may be authorized by the governor and council. Before incurring any expenses they shall from time to time estimate the amount required, and shall submit the same to the governor and council for their approval; and no expense shall be incurred by the commission beyond the amount so estimated and approved. Said commission shall receive such compensation as the governor and council may decide: *provided*, the whole amount expended under the provisions of this act shall not exceed ten thousand dollars.

SECTION 4. The county commissioners, boards of selectmen and aldermen, and other officers having authority over public ways, roads and bridges throughout the Commonwealth, shall at reasonable times, on request, furnish the commissioners any information required by them concerning the public ways, roads or bridges within their jurisdiction. The commissioners may furnish blank forms for returns to be made to them by such officers, and may make changes in and additions to such forms.

SECTION 5. The said commission shall report fully with plans and estimates and their recommendations to the legislature on or before the first Wednesday of February in the year eighteen hundred and ninety-three, and shall append to its report a draft of a bill intended to accomplish the recommendations of the commission.

SECTION 6. Any vacancy in the commission may be filled by the governor with the advice and consent of the council.

SECTION 7. This act shall take effect upon its passage.

Approved June 2, 1892.

[ACTS OF 1893, CHAPTER 476.]

AN ACT TO PROVIDE FOR THE APPOINTMENT OF A HIGHWAY COMMISSION TO IMPROVE THE PUBLIC ROADS AND TO DEFINE ITS POWERS AND DUTIES.

Be it enacted, etc., as follows:

Massachusetts
Highway Com-
mission, ap-

SECTION 1. The governor, with the advice and consent of the council, shall, within thirty days after the passage

of this act, appoint three competent persons, to serve as the Massachusetts Highway Commission. Their terms of office shall be so arranged and designated at the time of their appointment that the term of one member shall expire in three years, one in two years and one in one year. The full term of office thereafter shall be for three years, and all vacancies occurring shall be filled by the governor, with the advice and consent of the council. The members of said board may be removed by the governor, with the advice and consent of the council, for such cause as he shall deem sufficient and shall express in the order of removal. They shall each receive in full compensation for their services an annual salary of two thousand dollars, payable in equal monthly instalments, and also their travelling expenses. They may expend annually for clerk hire, engineers and for defraying expenses incidental to and necessary for the performance of their duties, exclusive of office rent, the sum of two thousand dollars. They shall be provided with an office in the state house or some other suitable place in the city of Boston, in which the records of their office shall be kept. They may establish rules and regulations for the conduct of business and for carrying out the provisions of this act.

pointment, term
of office, com-
pensation, etc.

SECTION 2. They shall from time to time compile statistics relating to the public roads of cities, towns and counties, and make such investigations relating thereto as they shall deem expedient. They may be consulted at all reasonable times, without charge, by officers of counties, cities or towns having the care of and authority over public roads, and shall without charge advise them relative to the construction, repair, alteration or maintenance of the same; but advice given by them to any such officers shall not impair the legal duties and obligations of any county, city or town. They shall prepare a map or maps of the Commonwealth on which shall be shown county, city and town boundaries and also the public roads, particularly the state highways, giving, when practicable, the names of the same. They shall collect and collate information concerning the geological formation of this Commonwealth, so far as it relates to the

To compile
statistics, make
investigations,
advise officers,
prepare maps,
etc.

Massachusetts
Highway Com-
mission to hold
public meetings.

material suitable and proper for road building, and shall, so far as practicable, designate on said map or maps the location of such material. Such map or maps shall at all reasonable times be open for the inspection of officers of counties, cities and towns having the care of and authority over public roads. They shall each year hold at least one public meeting in each county for the open discussion of questions relating to the public roads, due notice of which shall be given in the press or otherwise.

Annual report,
etc.

SECTION 3. They shall make an annual report to the legislature of their doings and the expenditures of their office, together with such statements, facts and explanations bearing upon the construction and maintenance of public roads, and such suggestions and recommendations as to the general policy of the Commonwealth in respect to the same as may seem to them appropriate. Their report shall be transmitted to the secretary of the Commonwealth on or before the first Wednesday in January of each year, to be laid before the legislature. All maps, plans and statistics collected and compiled under their direction shall be preserved in their office.

Officers to fur-
nish commis-
sion with infor-
mation.

SECTION 4. County commissioners and city and town officers having the care of and authority over public roads and bridges throughout the Commonwealth shall, on request, furnish the commissioners any information required by them concerning the roads and bridges within their jurisdiction.

Expenditure.

SECTION 5. For the purpose of carrying out the provisions of this act said commission may expend such sums for necessary assistants, the procuring of necessary supplies, instruments, material, machinery and other property, and for the construction and maintenance of state highways, as shall from time to time be appropriated by the legislature; and they shall in their annual report state what sums they deem necessary for the year commencing with the first day of March following.

State highway,
proceedings
upon petition
of county com-
missioners.
Repealed, 1894.

SECTION 6. Whenever the county commissioners of a county adjudge that the common necessity and convenience require that the Commonwealth acquire as a state

highway a new or an existing road in that county, they may apply by petition in writing to the Massachusetts highway commission, stating the road they recommend, and setting forth a detailed description of said road by metes and bounds, together with a plan and profile of the same. Said commission shall consider such petition, and if they adjudge that it ought to be allowed, they shall in writing so notify said county commissioners. It shall then become the duty of said county commissioners to cause said road to be surveyed and laid out in the manner provided for the laying out and alteration of highways, the entire expense thereof to be borne and paid by said county. Said county commissioners shall preserve a copy of such petition, plans and profiles with their records for public inspection. When said commission shall be satisfied that said county commissioners have properly surveyed and laid out said road, and set in place suitable monuments, and have furnished said commission with plans and profiles, on which shall be shown such monuments and established grades, in accordance with the rules and regulations of said commission, said commission may approve the same, and so notify in writing said county commissioners. Said commission shall then present a certified copy of said petition, on which their approval shall be indicated, together with their estimates for constructing said road and the estimated annual cost for maintaining the same, to the secretary of the Commonwealth, who shall at once lay the same before the legislature, if it is in session, otherwise on the second Wednesday of January following. If the legislature makes appropriation for constructing said road, said commission shall cause said road to be constructed in accordance with this act, and when completed and approved by them said road shall become a state highway, and thereafter be maintained by the Commonwealth under the supervision of said commission.

SECTION 7. Two or more cities or towns may petition the said commission representing that, in their opinion, the common necessity and convenience require that the Commonwealth should acquire as a state highway a new or

State highway,
proceedings
upon petition of
two or more
cities or towns.
Repealed, 1894.

an existing road leading from one city or town to another, which petition shall be accompanied by a detailed description of such road by metes and bounds, and also a plan and profile of the same. If said commission adjudge that the common necessity and convenience require such road to be laid out and acquired as a state highway, they shall cause a copy of said petition, on which shall be their finding, to be given to the county commissioners of the county in which said road or any portion of it lies. It shall then become the duty of the county commissioners, at the expense of the county, to cause said road to be surveyed and laid out, and to set in place suitable monuments and to cause a detailed description by metes and bounds, plans and profiles, to be made, on which shall be shown said monuments and established grades, and to give the same to said commission; but said county commissioners shall have the right to change the line of said road, provided the termini are substantially the same. Said county commissioners shall preserve said petition and a copy of the plans and profiles, with their records, for public inspection. When said commission shall be satisfied that the county commissioners have properly surveyed and laid out said road and set in place suitable monuments, and have furnished them with plans and profiles on which shall be shown said monuments and established grades, in accordance with the rules and regulations of said commission, they shall then proceed in the same manner as provided in section six of this act; and when said road is completed and approved by said commission it shall become a state highway, and thereafter be maintained by the Commonwealth under the supervision of said commission.

Grading, construction of culverts, bridges, etc., to be paid for by county. Repealed, 1894.

Action for damages.

SECTION 8. In all cases where a highway is to be constructed at the expense of the Commonwealth as a state highway, all the grading necessary to make said highway of the established grade, and the construction of culverts and bridges, shall be paid for by the county or counties, respectively, in which said highway or any portion of it lies, and the work must be done to the satisfaction of said commission. No action by a person claiming damage for the taking of land or change of grade, under the provi-

sions of this act, shall be commenced against a county until said commission has taken possession for the purpose of constructing such state highway.

SECTION 9. When appropriation has been made by the legislature for the construction of a state highway, said commission shall at once cause plans and specifications to be made and estimate the cost of the construction of such state highway, and give to each city and town in which said road lies, a certified copy of said plans and specifications, with a notice that said commission is ready for the construction of said road. Such city or town shall have the right, without advertisement, to contract with said commission for the construction of so much of such highway as lies within its limits, in accordance with the plans and specifications of the commission and under its supervision and subject to its approval, at a price agreed upon between said commission and said city or town; but such price agreed upon shall not exceed eighty-five per cent. of the original estimate of said commission. If such city or town shall within thirty days not elect to so contract, said commission may advertise in one or more papers published in the county where the road or portion of it is situated, and in one or more papers published in Boston, for bids for the construction of said highway in accordance with the plans and specifications furnished by said commission, and under their supervision and subject to their approval. Said commission shall have the right to reject any and all bids, and they shall require of the contractor a bond for at least ten thousand dollars for each mile of road, to indemnify such city or town in which such highway lies against damage while such road is being constructed, and the Commonwealth shall not be liable for any damage occasioned thereby. Said commission shall make and sign all contracts in the name of the Massachusetts highway commission.

Proceedings
when appropri-
ation is made
for construction.
Repealed, 1894.

SECTION 10. For the maintenance of state highways, said commission shall contract with the city or town in which such state highway lies, or a person, firm or corporation, for the keeping in repair and maintaining of such highway, in accordance with the rules and regula-

Maintenance.

tions of said commission, and subject to their supervision and approval, and such contracts may be made without previous advertisement.

Contracts subject to approval of governor and council.
Repealed, 1894.

SECTION 11. All contracts made by or with the Massachusetts highway commission under the provisions of this act shall be subject to the approval of the governor and council.

Rights of adjoining owner or occupant, etc.

SECTION 12. No length of possession, or occupancy of land within the limit of any state highway, by an owner or occupier of adjoining land, shall create a right to such land in any adjoining owner or occupant or a person claiming under him, and any fences, buildings, sheds or other obstructions encroaching upon such state highway shall, upon written notice by said commission, at once be removed by the owner or occupier of adjoining land, and if not so removed said commission may cause the same to be done and may remove the same upon the adjoining land of such owner or occupier.

State highway, liability for injuries to property or persons, etc.
Repealed, 1894.

SECTION 13. The Commonwealth shall be liable for injuries to persons or property occurring through a defect, or want of repair or of sufficient railing, in or upon a state highway.

Police jurisdiction, laying pipes, planting trees, etc.

SECTION 14. Cities and towns shall have police jurisdiction over all state highways, and they shall at once notify in writing the state commission or its employees of any defect or want of repair in such highways. No state highway shall be dug up for laying or placing pipes, sewers, posts, wires, railways or other purposes, and no tree shall be planted or removed or obstruction placed thereon, except by the written consent of the superintendent of streets or road commissioners of a city or town, approved by the highway commission, and then only in accordance with the rules and regulations of said commission; and in all cases the work shall be executed under the supervision and to the satisfaction of said commission, and the entire expense of replacing the highway in as good condition as before shall be paid by the parties to whom the consent was given or by whom the work was done; but a city or town shall have the right to dig up such state highway without such approval of the high-

way commission where immediate necessity demands it, but in all such cases such highway shall be at once replaced in as good condition as before, and at the expense of the city or town. Said commission shall give suitable names to the state highways, and they shall have the right to change the name of any road that shall have become a part of a state highway. They shall cause to be erected, at convenient points along state highways, suitable guide posts.

Names, guide posts, etc.

SECTION 15. The word "road," as used in this act includes every thoroughfare which the public has a right to use.

The word "road" defined.

SECTION 16. This act shall take effect upon its passage.

Approved June 10, 1893.

[ACTS OF 1894, CHAPTER 497.]

AN ACT RELATING TO STATE HIGHWAYS.

Be it enacted, etc., as follows :

SECTION 1. Whenever the county commissioners of a county, or the mayor and aldermen of a city, or the selectmen of a town, adjudge that the public necessity and convenience require that the Commonwealth take charge of a new or an existing road as a highway, in whole or in part, in that county, city or town, they may apply by a petition in writing to the Massachusetts highway commission, stating the road they recommend, together with a plan and profile of the same.

Petition for the taking of certain roads as state highways.

SECTION 2. Said highway commission shall consider such petition and determine what the public necessity and convenience require in the premises, and, if they deem that the highway should be laid out or be taken charge of by the Commonwealth, shall file a plan thereof in the office of the county commissioners of the county in which the petitioners reside, with the petition therefor and a certificate that they have laid out and taken charge of said highway in accordance with said plan, and shall file a copy of the plan and location of the portion lying in each city or town

Proceedings of highway commissioners upon petition, etc.

in the office of the clerk of said city or town, and said highway shall, after the filing of said plans, be laid out as a highway, and shall be constructed and kept in good repair and condition as a highway by the said commission, at the expense of the Commonwealth, and shall be known as a state road, and thereafter be maintained by the Commonwealth under the supervision of said commission. And all openings and placing of structures in any such road shall be done in accordance with a permit from said commission.

Damages.

SECTION 3. The damages sustained by any person whose property is taken for, or is injured by the construction of any such highway shall be paid by the Commonwealth, the same to be determined by said commission. And if said commission and the person sustaining the damages cannot agree thereon he or they may have said damages determined by a jury in the county in which the land is situated, by filing a petition for such jury in the office of the clerk of the superior court for said county at any time before the expiration of one year from the completion of said highway, and thereupon said damages shall be determined by a jury at the bar of said court, in the same manner as damages for the taking of land for other highways in the county, city or town are determined; and costs shall be taxed to the prevailing party on such petition, as in civil cases.

Construction of highways, notice to cities and towns, bids, proposals, etc.

SECTION 4. Said commission shall, when about to construct any highway, give to each city and town in which said highway lies a certified copy of the plans and specifications for said highway, with a notice that said commission is ready for the construction of said road. Such city or town shall have the right, without advertisement, to contract with said commission for the construction of so much of such highway as lies within its limits, in accordance with the plans and specifications, and under its supervision and subject to its approval, at a price agreed upon between said commission and said city or town. If said city or town shall not elect to so contract within thirty days said commission shall advertise in two or more papers published in the county where the road or portion of it

is situated, and in three or more daily papers published in Boston, for bids for the construction of said highway under their supervision and subject to their approval, in accordance with plans and specifications to be furnished by said commission. Such advertisements shall state the time and place for opening the proposals in answer to said advertisements, and reserve the right to reject any and all proposals. All such proposals shall be sealed and shall be kept by the board, and shall be open to public inspection after said proposals have been accepted or rejected. Said commission may reject any or all bids, or if a bid is satisfactory they shall, with the approval of the governor and council, make a contract in writing on behalf of the Commonwealth for said construction, and shall require of the contractor a bond for at least twenty-five per cent. of the contract price to indemnify any city or town in which such highway lies against damage while such road is being constructed; and the Commonwealth shall not be liable for any damage occasioned thereby. All construction of state roads shall be fairly apportioned by said commission among the different counties, and not more than ten miles of state road shall be constructed in any one county in any one year on petition as aforesaid, without the previous approval thereof in writing by the governor and council.

Construction to be apportioned among the different counties.

SECTION 5. One quarter of any money expended under the provisions of this act in any county for a highway, with interest on said quarter at the rate of three per cent. per annum, shall be repaid by said county to the Commonwealth, in such reasonable sums and at such times within six years thereafter as said commission, with the approval of the state auditor, shall determine, taking into consideration the financial condition of the county; and the treasurer and receiver-general shall apply all money so repaid to the appropriation to be expended by said commission. The county treasurer, with the approval of the county commissioners, may make such loans as they may see fit to meet this expenditure.

Portion of money expended to be repaid by county, etc.

SECTION 6. Any city or town in which a state highway is situated shall be liable for injuries to persons

Cities and towns to be liable for injuries to persons, etc.

travelling upon a state highway the same as upon other highways, but the amount actually recovered as damages for such injuries shall be repaid within one year thereafter to such city or town by the Commonwealth. A city or town may make temporary necessary repairs of a state highway without the approval of said commission.

Shade trees,
watering
troughs, etc.

SECTION 7. Said commission shall keep all state roads reasonably clear of brush, and shall cause suitable shade trees to be set out along said highways when feasible, and shall renew the same when necessary, and may also establish and maintain watering troughs at suitable places along said highways.

State Highway
Loan.

SECTION 8. For the purpose of meeting any expenses that may be incurred under the provisions of chapter four hundred and seventy-six of the acts of the year eighteen hundred and ninety-three, as hereby amended, including the salaries and expenses of the commission, the treasurer and receiver-general is hereby authorized, with the approval of the governor and council, to issue scrip or certificates of indebtedness to an amount not exceeding three hundred thousand dollars, for a term not exceeding thirty years. Said scrip or certificates of indebtedness shall be issued as registered bonds or with interest coupons attached, and shall bear interest not exceeding four per centum per annum, payable semi-annually on the first days of April and October in each year. Such scrip or certificates of indebtedness shall be designated on the face as the State Highway Loan, shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth, and the principal and interest shall be paid at the times specified therein in gold coin of the United States or its equivalent; and said scrip or certificates of indebtedness shall be sold and disposed of at public auction or in such other mode and at such times and prices and in such amounts and at such rates of interest, not exceeding the rate above specified, as shall be deemed best. The treasurer and receiver-general shall, on issuing any of said scrip or certificates of indebtedness, establish a sinking fund for the payment of said

Sinking fund.

bonds, into which shall be paid any premiums received on the sale of said bonds, and he shall apportion thereto from year to year, in addition, amounts sufficient with the accumulations to extinguish at maturity the debt incurred by the issue of said bonds. The amount necessary to meet the annual sinking fund requirements and to pay the interest on said bonds shall be raised by taxation from year to year.

SECTION 9. Sections six, seven, eight, nine, eleven Repeal. and thirteen of chapter four hundred and seventy-six of the acts of the year eighteen hundred and ninety-three are hereby repealed.

SECTION 10. This act shall take effect upon its passage.

Approved June 20, 1894.

[ACTS OF 1895, CHAPTER 92.]

AN ACT MAKING APPROPRIATIONS FOR EXPENSES OF THE
MASSACHUSETTS HIGHWAY COMMISSION.

Be it enacted, etc., as follows :

SECTION 1. The sums hereinafter mentioned are ap- Appropriations.
propriated, to be paid out of the state highway loan
fund, to meet expenses of the Massachusetts highway
commission for the year ending on the thirty-first day of
December in the year eighteen hundred and ninety-five,
to wit : —

For rent of office, including care, heating and lighting Highway com-
mission, rent,
etc.
the same, a sum not exceeding one thousand dollars, this
amount being in addition to the sum heretofore appro-
priated for rent in an act passed the present year.

For the salaries of clerks and such clerical assistance Clerks.
as said commission may find necessary, a sum not exceed-
ing five thousand dollars.

For the salary of the chief engineer, a sum not exceed- Chief engineer.
ing three thousand dollars.

For incidental and contingent expenses of said com- Incidental
expenses.
mission, a sum not exceeding fifteen hundred dollars.

Travelling expenses.

For travelling expenses of said commission, a sum not exceeding fifteen hundred dollars.

Surveys of roads.

For expenses in connection with surveys of roads, for the purpose of laying out and building state highways, a sum not exceeding ten thousand dollars.

SECTION 2. This act shall take effect upon its passage.

Approved March 7, 1895.

[ACTS OF 1895, CHAPTER 347.]

AN ACT RELATIVE TO THE CONSTRUCTION OF STATE HIGHWAYS.

Be it enacted, etc., as follows :

Construction of state highways.

SECTION 1. The Massachusetts highway commission is hereby authorized to expend a sum not exceeding four hundred thousand dollars for the construction of state highways during the current year, in accordance with the provisions of chapter four hundred and seventy-six of the acts of the year eighteen hundred and ninety-three and chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four.

No persons except citizens to be employed.

SECTION 2. No persons except citizens of this Commonwealth shall be employed on the work authorized by this act.

State Highway Loan.

SECTION 3. For the purpose of meeting any expenses which may be incurred under the provisions of this act the treasurer and receiver-general is hereby authorized, with the approval of the governor and council, to issue scrip or certificates of indebtedness to an amount not exceeding four hundred thousand dollars, for a term not exceeding thirty years. Said scrip or certificates of indebtedness shall be issued as registered bonds or with interest coupons attached, and shall bear interest not exceeding four per cent. per annum, payable semi-annually on the first days of April and October in each year. Such scrip or certificates of indebtedness shall be designated on their face as the State Highway Loan, shall be countersigned by the governor, and shall be deemed the

pledge of the faith and credit of the Commonwealth; and the principal and interest thereof shall be paid at the times specified therein in gold coin of the United States or its equivalent; and said scrip or certificates of indebtedness shall be sold and disposed of at public auction, or in such other manner, at such times and prices, in such amounts and at such rates of interest, not exceeding the rate above specified, as shall be deemed best. The sinking fund established by chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four shall also be maintained for the purpose of extinguishing bonds issued under the authority of this act, and the treasurer and receiver-general shall apportion thereto from year to year an amount sufficient with the accumulations of said fund to extinguish at maturity the debt incurred by the issue of said bonds. The amount necessary to meet the annual sinking fund requirements and to pay the interest on said bonds shall be raised by taxation from year to year. Sinking funds.

SECTION 4. This act shall take effect upon its passage.

Approved May 1, 1895.

[ACTS OF 1895, CHAPTER 486.]

AN ACT RELATIVE TO THE CONSTRUCTION OF MACADAMIZED
ROADS IN TOWNS.

Be it enacted, etc., as follows:

SECTION 1. When a town of not less than ten thousand inhabitants, or not less than two nor more than five adjoining towns whose combined population does not exceed twelve thousand, vote at a town meeting to expend not less than three thousand dollars per year each year for the term of five years, in the case of a single town, or four thousand dollars each year for the term of five years when not less than two nor more than five towns unite together, for macadamized roads, the Commonwealth shall furnish out of the state highway loan authorized by chapter three hundred and forty-seven of the acts of the present Commonwealth
to furnish
certain towns
with steam
road rollers.

Proviso.

year, through the Massachusetts highway commission, to such town or towns, free of charge a steam road roller of approved pattern and suitable size, for the sole use of such town or towns during said five years and as long thereafter as they continue to expend not less than fifty per cent. of the above-mentioned sum on macadamized roads each year: *provided, nevertheless*, that if said town or towns fail to expend said sum for macadamized roads in any one year, such road roller shall then revert to the Commonwealth. Said town or towns shall keep said roller in good repair.

Joint use of rollers by certain towns.

SECTION 2. When not less than two nor more than five towns use a roller jointly, the town voting the largest proportion of the required sum shall have the first chance as to the time of using it, and may retain possession of it each year for a length of time proportionate to the sum voted by said town. The six months between the first day of May and the first day of November in each year shall be deemed the proper period for macadamizing roads.

Period for macadamizing roads.

Amount to be expended.

SECTION 3. The Massachusetts highway commission shall not expend more than nine thousand dollars in carrying out the provisions of this act during the year eighteen hundred and ninety-five.

SECTION 4. This act shall take effect upon its passage.

Approved June 5, 1895.

[RESOLVES OF 1896, CHAPTER 86.]

RESOLVE RELATIVE TO A STATE HIGHWAY BETWEEN THE CITY OF BOSTON AND THE CITY OF NEWBURYPORT.

State highway between Boston and Newburyport.

Resolved, That the Massachusetts highway commission consider the expediency of laying out a state highway between the city of Boston and the city of Salem or the city of Newburyport, over the shore route, so called, which route may be described substantially as follows:—

Starting from the south ferry, at Lewis street, in Boston, thence through Lewis street to Maverick square, thence through Maverick square to Chelsea street, thence over Chelsea street to Bennington street, thence over

Bennington street to Orient Heights, thence over the main traveled road to the town of Revere, continuing on the main road to Beachmont, continuing over the main traveled road, known as Ocean avenue, along the ocean front to the Point of Pines, crossing the Saugus river on the easterly side of the Boston, Revere Beach and Lynn railroad and running to the south end of Sea street in Lynn, thence through Sea street to Broad street, thence through Broad street to Lewis street, thence through Lewis street to New Ocean street, thence through New Ocean street to the town of Swampscott, thence through New Ocean street, in Swampscott, to the junction of Burrill street and Paradise road, thence over Paradise road to the north-east end of said road, thence through Paradise woods on nearly a straight line to Vinin square, at the junction of the towns of Swampscott and Marblehead and the city of Salem, thence northerly to Loring avenue in the city of Salem, thence over Loring avenue to Lafayette street, thence over Lafayette street to Central street, thence over Central street to Essex street, thence through Salem to and over Beverly bridge, thence through the city of Beverly, and thence to Newburyport, using the present traveled roads as far as may be, with such additions of new road as may be necessary. Said Massachusetts highway commission shall report to the next general court the probable cost of such a highway, with such other information as may be obtained in relation thereto, on or before the thirty-first day of January in the year eighteen hundred and ninety-seven.

Approved April 28, 1896.

[ACTS OF 1896, CHAPTER 345.]

AN ACT RELATIVE TO STATE HIGHWAYS.

Be it enacted, etc., as follows:

SECTION 1. When a highway is laid out as a state road the Massachusetts highway commission shall construct and maintain that portion of the way between the inside lines of sidewalks upon either side. The sidewalks of said road may be constructed and maintained in accordance with the

Construction,
etc., of state
highways.

Sidewalks.

Public Statutes and amendments thereto, and the provisions of section six of chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four shall only apply to that portion of the way between the inside lines of sidewalks. The inside lines of sidewalks referred to in this section are those lines which are nearest to the centre of the highway.

State roads to be kept clear of snow and ice, etc.

SECTION 2. A city or town in which a state road lies shall at its own expense keep such road sufficiently clear of snow and ice so that the same shall be reasonably safe for travel, as now required by the Public Statutes and amendments thereto.

Copy of petition may be filed with county commissioners.

SECTION 3. Instead of filing the original petition with the county commissioners, as now required by section two of chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four, it shall hereafter be sufficient to file a certified copy thereof with said county commissioners.

SECTION 4. This act shall take effect upon its passage.

Approved April 28, 1896.

[ACTS OF 1896, CHAPTER 481.]

AN ACT RELATIVE TO THE CONSTRUCTION OF STATE
HIGHWAYS.

Be it enacted, etc., as follows :

Construction of state highways.

SECTION 1. The Massachusetts highway commission is hereby authorized to expend a sum not exceeding six hundred thousand dollars for the construction of state highways, in accordance with the provisions of chapter four hundred and seventy-six of the acts of the year eighteen hundred and ninety-three and chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four.

Only citizens of the Commonwealth to be employed.

SECTION 2. No persons except citizens of this Commonwealth shall be employed on the work authorized by this act.

State Highway Loan.

SECTION 3. For the purpose of meeting any expenses which may be incurred under the provisions of this act the treasurer and receiver general is hereby authorized,

with the approval of the governor and council, to issue scrip or certificates of indebtedness to an amount not exceeding six hundred thousand dollars, for a term not exceeding thirty years. Said scrip or certificates of indebtedness shall be issued as registered bonds or with interest coupons attached, and shall bear interest not exceeding four per cent. per annum, payable semi-annually on the first day of April and of October in each year. Such scrip or certificates of indebtedness shall be designated on their face as the State Highway Loan, shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth; and the principal and interest thereof shall be paid at the times specified therein in gold coin of the United States or its equivalent, and said scrip or certificates of indebtedness shall be sold and disposed of at public auction, or in such other manner, at such times and prices, in such amounts and at such rates of interest, not exceeding the rate above-specified, as shall be deemed best. The sinking fund established by chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four shall also be maintained for the purpose of extinguishing bonds issued under the authority of this act, and the treasurer and receiver general shall apportion thereto from year to year an amount sufficient with the accumulations of said fund to extinguish at maturity the debt incurred by the issue of said bonds. The amount necessary to meet the annual sinking fund requirements and to pay the interest on said bonds shall be raised by taxation from year to year.

Sinking fund,
etc.

SECTION 4. This act shall take effect upon its passage.

Approved June 4, 1896.

[ACTS OF 1896, CHAPTER 513.]

AN ACT TO PROVIDE FOR AIDING TOWNS IN THE CONSTRUCTION AND MAINTENANCE OF BETTER ROADS.

Be it enacted, etc., as follows:

SECTION 1. Upon the application to the Massachusetts highway commission of the county commissioners of any

Road machines
to be furnished
at the expense

of the Commonwealth for use in certain towns, etc.

county, made at the request of any town of not more than twelve thousand inhabitants within said county, there shall be furnished by said highway commission to said county, at the expense of the Commonwealth, one or more steam rollers, portable stone crushers and such other road machines as the said highway commission may deem necessary for the construction and maintenance of better roads in the town making such request. Such machines shall remain the property of the Commonwealth and shall be managed and maintained under the direction of the county commissioners. The county commissioners shall engage competent engineers and skilled mechanics to operate said machines, who shall be paid from the county treasury such sums for each day's actual services as the county commissioners may determine. The expenses so incurred shall be repaid to the county by the towns using said machines, as apportioned by the county commissioners, in proportion to the time in which such machines were used by them.

Repeal.

SECTION 2. Chapter four hundred and eighty-six of the acts of the year eighteen hundred and ninety-five is hereby repealed.

SECTION 3. This act shall take effect upon its passage.

Approved June 6, 1896.

[ACTS OF 1896, CHAPTER 541.]

AN ACT RELATIVE TO STREET RAILWAYS LOCATED ON STATE HIGHWAYS.

Be it enacted, etc., as follows :

Location of street railways on state highways may be changed, etc.

SECTION 1. Whenever in the construction of a state highway it becomes necessary, in the opinion of the Massachusetts highway commission, to change the location, relay or change the grade of that part of any street railway located on said highway, or to place different material between its tracks, or to make any other change in the location and construction of said railway, said commission may, in the manner provided in section twenty-two of chapter one hundred and thirteen of the Public Statutes for making such changes by boards of aldermen and select-

men, order the company owning or operating said railway to make such changes : *provided, however*, that the company shall thereafter enjoy the same rights in the new location that it had in the original location ; and unless the same are made within the time limited by said commission the commission may make said changes, and the cost of making the same, whether by the railway company or by said commission, shall be paid by said commission ; said cost with interest at a rate not exceeding four per cent. per annum, shall be paid by said railway company to the Commonwealth in ten equal annual payments ; and the auditor of the Commonwealth on or before the first day of July in each year shall certify the amount due to the tax commissioner, who shall forthwith demand the same ; and payment shall be made within thirty days thereafter. The claim of the Commonwealth shall have priority over all other claims against said railway company, except for labor, and shall be collected in the same manner as the corporation tax ; but any such company may itself pay for the expenses of said changes at the time of making the same, and may anticipate said annual payments in whole or in part.

SECTION 2. This act shall take effect upon its passage.

Approved June 9, 1896.

[ACTS OF 1896, CHAPTER 548.]

AN ACT MAKING APPROPRIATIONS FOR EXPENSES AUTHORIZED BY THE PRESENT LEGISLATURE AND FOR CERTAIN OTHER EXPENSES AUTHORIZED BY LAW.

Be it enacted, etc., as follows :

For expenses in connection with aiding towns in the construction and maintenance of better roads, as authorized by chapter five hundred and thirteen of the acts of the present year, a sum not exceeding twelve thousand dollars.

Construction of
better roads.

SECTION 2. This act shall take effect upon its passage.

Approved June 9, 1896.

[ACTS OF 1897, CHAPTER 15.]

AN ACT MAKING AN APPROPRIATION FOR THE STATE
HIGHWAY LOAN SINKING FUND.*Be it enacted, etc., as follows:*

Appropriation
of \$28,372 for
State Highway
Loan Sinking
Fund.

SECTION 1. The sum of twenty-eight thousand three hundred and seventy-two dollars is hereby appropriated, to be paid out of the treasury of the Commonwealth from the ordinary revenue, for the State Highway Loan Sinking Fund, as provided for in section eight of chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four, said sum being the estimate of the treasurer and receiver-general.

SECTION 2. This act shall take effect upon its passage.

Approved February 2, 1897.

[ACTS OF 1897, CHAPTER 276.]

AN ACT TO PERMIT THE RELOCATION OF A CERTAIN HIGH-
WAY OVER THE LAND OF THE TRUSTEES OF THE WEST-
BOROUGH INSANE HOSPITAL.*Be it enacted, etc., as follows:*

Highway over
Westborough
insane hospital
land, etc.

SECTION 1. The trustees of the Westborough insane hospital are hereby authorized to permit the relocation of the highway leading over land of the said trustees, past the buildings of the Westborough insane hospital, over other land of the said trustees, in such place and according to such plan as the said trustees may approve. And the Massachusetts highway commission may relocate and build said highway during the year eighteen hundred and ninety-seven, and may pay for building the same out of any funds that may hereafter be authorized to be expended by said commission.

SECTION 2. This act shall take effect upon its passage.

Approved April 14, 1897.

[ACTS OF 1897, CHAPTER 340.]

AN ACT RELATIVE TO THE CONSTRUCTION AND REPAIR OF
STATE HIGHWAYS.*Be it enacted, etc., as follows :*

SECTION 1. The Massachusetts highway commission is hereby authorized to expend a sum not exceeding eight hundred thousand dollars for the construction and repair of state highways, in accordance with the provisions of the statutes relating to and defining the powers and duties of said commission. Said commission may make contracts during the present calendar year for the whole amount hereby authorized to be expended, but the contracts shall be so made that the amount to be paid from the state treasury during the present calendar year shall not exceed six hundred thousand dollars.

Highway
Commission
may expend
\$800,000.

\$600,000 only to
be used in 1897.

SECTION 2. No persons except citizens of this Commonwealth shall be employed on the work authorized by this act.

Citizens of
Massachusetts
only to be
employed.

SECTION 3. For the purpose of meeting any expenses which may be incurred under the provisions of this act the treasurer and receiver-general is hereby authorized, with the approval of the governor and council, to issue scrip or certificates of indebtedness to an amount not exceeding eight hundred thousand dollars, for a term not exceeding thirty years. Said scrip or certificates of indebtedness shall be issued as registered bonds or with interest coupons attached, and shall bear interest not exceeding four per cent. per annum, payable semi-annually on the first days of April and October in each year. Such scrip or certificates of indebtedness shall be designated on their face as the State Highway Loan, shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth; and the principal and interest thereof shall be paid at the times specified therein in gold coin of the United States or its equivalent, and said scrip or certificates of indebtedness shall be sold and disposed of at public auction, or in such other manner, at such times and prices, in such amounts and at such rates of interest, not exceeding the

Loan authorized
of \$800,000, not
exceeding 30
years, not ex-
ceeding 4 per
cent. interest,
April and
October.

State Highway
Loan.

Gold coin of the
United States or
its equivalent.

Sinking fund
already estab-
lished to cover
this loan.

Amount
necessary to
be raised by
taxation.

rate above-specified, as shall be deemed best. The sinking fund established by chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four shall also be maintained for the purpose of extinguishing bonds issued under the authority of this act, and the treasurer and receiver general shall apportion thereto from year to year an amount sufficient with the accumulations of said fund to extinguish at maturity the debt incurred by the issue of said bonds. The amount necessary to meet the annual sinking fund requirements and to pay the interest on said bonds shall be raised by taxation from year to year.

SECTION 4. This act shall take effect upon its passage.

Approved May 5, 1897.

[ACTS OF 1897, CHAPTER 355.]

AN ACT RELATIVE TO STATE HIGHWAYS.

Be it enacted, etc., as follows :

Chap. 407, 1894,
amended.

SECTION 1. Section two of chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four is hereby amended by inserting after the word "file", in the fifth line of said section, the words:—a certified copy of,—and by striking out the last sentence of said section and inserting in place thereof the words:—No opening shall be made in any such road, nor any structure placed therein, nor shall there be made any change or removal of structures already placed therein, except with the approval of and in accordance with a permit from said commission, which shall exercise complete and permanent jurisdiction over state highways,—so as to read as follows:—*Section 2.* Said highway commission shall consider such petition and determine what the public necessity and convenience require in the premises, and, if they deem that the highway should be laid out or be taken charge of by the Commonwealth, shall file a certified copy of a plan thereof in the office of the county commissioners of the county in which the petitioners reside, with the petition therefor and a certificate that they have laid out and taken charge

Highway com-
missioners to
receive petitions
for highways,
and their duties
in such cases
defined.

of said highway in accordance with said plan, and shall file a copy of the plan and location of the portion lying in each city or town in the office of the clerk of said city or town, and said highway shall, after the filing of said plans, be laid out as a highway, and shall be constructed and kept in good repair and condition as a highway by said commission, at the expense of the Commonwealth, and shall be known as a state road, and thereafter be maintained by the Commonwealth under the supervision of said commission. No opening shall be made in any such road, nor any structure placed therein, nor shall there be made any change or removal of structures already placed therein, except with the approval of and in accordance with a permit from said commission, which shall exercise complete and permanent jurisdiction over state highways.

SECTION 2. Section four of said chapter four hundred and ninety-seven is hereby amended by inserting after the word "thereby", in the thirty-third line, the words:—The commission shall also have power to contract in the manner and under the conditions hereinbefore specified with a city or town, or with private bidders when a city or town shall not elect so to contract, for the grading of a state highway, or for furnishing materials or any other element in the construction of such highway,—so as to read as follows:—*Section 4.* Said commission shall, when about to construct any highway, give to each city and town in which said highway lies a certified copy of the plans and specifications for said highway, with a notice that said commission is ready for the construction of said road. Such city or town shall have the right, without advertisement, to contract with said commission for the construction of so much of such highway as lies within its limits, in accordance with the plans and specifications, and under its supervision and subject to its approval, at a price agreed upon between said commission and said city or town. If said city or town shall not elect to so contract within thirty days said commission shall advertise in two or more papers published in the county where the road or portion of it is situated, and in three or more daily papers published in

Chap. 497, 1894,
amended.

Commission to
furnish plans
to towns and
cities, etc.

Cities and towns
may contract
with commis-
sion to construct
highways.

Commission
may advertise
for bids in
certain cases.

Boston, for bids for the construction of said highway under their supervision and subject to their approval, in accordance with plans and specifications to be furnished by said commission. Such advertisement shall state the time and place for opening the proposals in answer to said advertisements, and reserve the right to reject any and all proposals. All such proposals shall be sealed and shall be kept by the board, and shall be open to public inspection after said proposals have been accepted or

May reject bids. rejected. Said commission may reject any or all bids, or if a bid is satisfactory they shall, with the approval of the governor and council, make a contract in writing on behalf of the Commonwealth for said construction, and shall require of the contractor a bond for at least twenty-five per cent. of the contract price to indemnify any city or town in which such highway lies, against damage while such road is being constructed; and the Commonwealth shall not be liable for any damage occasioned thereby. The commission shall also have power to contract in the manner and under the conditions hereinbefore specified with a city or town, or with private bidders when a city or town shall not elect so to contract, for the grading of a state highway, or for furnishing materials or any other element in the construction of such highway. All construction of state roads shall be fairly apportioned by said commission among the different counties, and not more than ten miles of state road shall be constructed in any one county in any one year on petition as aforesaid, without the previous approval thereof in writing by the governor and council.

Not more than 10 miles of road to be constructed in any county in any one year unless, etc.

Chap. 518, 1896, amended.

Commission may furnish counties, at expense of Commonwealth, steam rollers, crushers, etc.

SECTION 8. Section one of chapter five hundred and thirteen of the acts of the year eighteen hundred and ninety-six is hereby amended by striking out the whole of said section and inserting in place thereof the following:—

Section 1. Upon the application to the Massachusetts highway commission of the county commissioners of any county, made at the request of any town of not more than twelve thousand inhabitants within said county, there shall be furnished by said highway commission to said county, at the expense of the Commonwealth, such steam rollers, portable stone crushers, and other road machines

as the said highway commission may deem necessary for the construction and maintenance of better roads in the county from which such a request comes. Such machines shall remain the property of the Commonwealth and shall be managed and maintained under the direction of the county commissioners, and they shall at all times be cared for in a manner satisfactory to the highway commission. The county commissioners shall engage competent engineers and skilled mechanics to operate said machines, who shall be paid from the county treasury such sums for each day's actual services as the county commissioners may determine. The expenses so incurred shall be repaid to the county by the Commonwealth or by the towns using said machines, as apportioned by the county commissioners, in proportion to the time during which such machines were used by such towns. Whenever any part of a state highway shall have been constructed in a county where there is road machinery purchased under the provisions of this act the highway commission shall have the right to use said machinery at such times as said road machinery is not in use by any town, for the maintenance and repair of such highway.

Such machines to remain property of Commonwealth under care of county commissioners, etc.

Expenses of said machines to be repaid by counties or towns.

Commission has right to use said machines.

SECTION 4. The provisions of section one of chapter five hundred and forty-one of the acts of the year eighteen hundred and ninety-six shall apply to the repair of a state highway as well as to the construction thereof.

SECTION 5. All payments made to the Commonwealth under the provisions of said chapter five hundred and forty-one shall be credited to the fund for the construction of state highways: *provided*, that such a fund exists at the time the payment is made, otherwise they shall be credited to the general fund of the Commonwealth.

Approved May 6, 1897.

[RESOLVES OF 1897, CHAPTER 95.]

RESOLVE TO PROVIDE FOR ADDITIONAL COPIES OF THE REPORT OF THE MASSACHUSETTS HIGHWAY COMMISSION.

Resolved, That two thousand additional copies of the fourth annual report of the Massachusetts highway com-

2,000 additional copies of report to be printed.

mission be printed and bound in cloth. Out of the number so printed each member of the present general court shall be entitled to receive five copies, and the residue shall be distributed under the direction of the commission. Beginning with the year eighteen hundred and ninety-eight there shall be printed annually four thousand copies of the report of said commission, and each member of the general court shall be entitled to receive ten copies.

Approved June 11, 1897.

[ACTS OF 1898, CHAPTER 38.]

AN ACT MAKING AN APPROPRIATION FOR THE STATE HIGHWAY LOAN SINKING FUND.

Be it enacted, etc., as follows :

State Highway
Loan Sinking
Fund.

SECTION 1. The sum of forty-seven thousand two hundred seventy-three dollars and fifty-seven cents is hereby appropriated, to be paid out of the treasury of the Commonwealth from the ordinary revenue, for the State Highway Loan Sinking Fund, as provided for by section eight of chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four, said sum being the estimate of the treasurer and receiver general.

SECTION 2. This act shall take effect upon its passage.

Approved February 8, 1898.

[ACTS OF 1898, CHAPTER 476.]

AN ACT RELATIVE TO STATE HIGHWAYS.

Be it enacted, etc., as follows :

1894, 497, § 1,
amended.

SECTION 1. Section one of chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four is hereby amended by striking out all after the word "commission", in the seventh and eighth lines, and inserting in place thereof the words:—requesting that said road may be taken charge of by the Commonwealth,—so as to read as follows: *Section 1.* Whenever the county commissioners of a county, or the mayor and aldermen of a city, or the selectmen of a town, ad-

Petition for the
taking of cer-
tain roads as
state highways.

judge that the public necessity and convenience require that the Commonwealth take charge of a new or an existing road as a highway, in whole or in part, in that county, city or town, they may apply by a petition in writing to the Massachusetts highway commission, requesting that said road may be taken charge of by the Commonwealth.

SECTION 2. This act shall take effect upon its passage.

Approved May 27, 1898.

[ACTS OF 1898, CHAPTER 528.]

AN ACT RELATIVE TO STATE HIGHWAYS.

Be it enacted, etc., as follows :

SECTION 1. Section one of chapter four hundred and seventy-six of the acts of the year eighteen hundred and ninety-three is hereby amended by striking out all after the word "removal", in the fourteenth line, and inserting in place thereof the following:—They shall each receive, in full compensation for their services, an annual salary of two thousand dollars, payable in equal monthly instalments, and also their travelling expenses, and they may expend annually for clerk hire, engineers, and for defraying expenses incidental and necessary for the performance of their duties, exclusive of office rent, such sum as the legislature shall from time to time appropriate. All of these sums shall be paid from the treasury of the Commonwealth. They shall be provided with an office in the state house or some other suitable place in the city of Boston, in which the records of their office shall be kept. They may establish rules and regulations for the conduct of business and for carrying out the provisions of the different acts governing the state highway commission.

1893, 476, § 1,
amended.

Compensation
of state highway
commissioners,
etc.

SECTION 2. All acts and parts of acts inconsistent with this act are hereby repealed.

SECTION 3. This act shall take effect upon its passage.

Approved June 14, 1898.

[ACTS OF 1896, CHAPTER 539.]

AN ACT RELATIVE TO THE CONSTRUCTION AND REPAIR OF
STATE HIGHWAYS.*Be it enacted, etc., as follows :*Construction
and repair of
state highways.

SECTION 1. The Massachusetts highway commission is hereby authorized to expend a sum not exceeding four hundred thousand dollars for the construction and repair of state highways, in accordance with the provisions of the statutes relating to and defining the powers and duties of said commission. Said commission may make contracts during the present calendar year for the whole amount hereby authorized to be expended, but the contracts shall be so made that the amount to be paid from the state treasury during the present calendar year shall not exceed three hundred thousand dollars.

Only citizens to
be employed.

SECTION 2. No persons except citizens of this Commonwealth shall be employed on the work authorized by this act.

State Highway
Loan.

SECTION 3. For the purpose of meeting any expenses which may be incurred under the provisions of this act, the treasurer and receiver general is hereby authorized, with the approval of the governor and council, to issue scrip or certificates of indebtedness to an amount not exceeding four hundred thousand dollars, for a term not exceeding thirty years. Said scrip or certificates of indebtedness shall be issued as registered bonds or with interest coupons attached, and shall bear interest not exceeding four per cent. per annum, payable semi-annually on the first day of April and of October in each year. Such scrip or certificates of indebtedness shall be designated on their face as the State Highway Loan, shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth; and the principal and interest thereof shall be paid at the times specified therein in gold coin of the United States or its equivalent, and said scrip or certificates of indebtedness shall be sold and disposed of at public auction, or in such other manner, at such times and prices, in such amounts and at such rates of interest, not exceeding the rate above specified, as shall be deemed

best. The sinking fund established by chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four shall also be maintained for the purpose of providing for the payment of the bonds issued under the authority of this act, and the treasurer and receiver general shall apportion thereto from year to year an amount sufficient with the accumulations of said fund to extinguish at maturity the debt incurred by the issue of said bonds. The amount necessary to meet the annual sinking fund requirements and to pay the interest on said bonds shall be raised by taxation from year to year.

SECTION 4. This act shall take effect upon its passage.

Approved June 17, 1898.

[ACTS OF 1898, CHAPTER 579.]

AN ACT IN ADDITION TO THE SEVERAL ACTS MAKING APPROPRIATIONS FOR EXPENSES AUTHORIZED DURING THE PRESENT YEAR, AND FOR CERTAIN OTHER EXPENSES AUTHORIZED BY LAW.

Be it enacted, etc., as follows:

SECTION 1. . . . For the salaries and expenses of the Massachusetts state highway commission, the same to include clerk hire, engineers and expenses incidental and necessary for the performance of their duties, from and after the fourteenth day of June in the present year, as provided for by chapter five hundred and twenty-eight of the acts of the present year, a sum not exceeding fourteen thousand three hundred dollars. . . .

Massachusetts
highway com-
mission.

SECTION 2. This act shall take effect upon its passage.

Approved June 23, 1898.

[RESOLVES OF 1898, CHAPTER 106.]

RESOLVE RELATIVE TO STATE HIGHWAYS IN THE CITIES OF BEVERLY AND GLOUCESTER AND THE TOWNS OF MANCHESTER AND ROCKPORT.

Resolved, That the Massachusetts highway commission is hereby authorized and instructed to make a plan show-

State highways
in Beverly,
Gloucester, etc.

ing the line and grade of the highway passing through the cities of Beverly and Gloucester and the towns of Manchester and Rockport, and known as Hale street, Bridge street, Central street, Union street, Washington street, Summer street, Western avenue and Main street, to Railroad avenue in the town of Rockport.

Approved June 7, 1898.

[ACTS OF 1899, CHAPTER 367.]

AN ACT MAKING APPROPRIATIONS FOR THE MASSACHUSETTS
HIGHWAY COMMISSION.

Be it enacted, etc., as follows :

Appropriation
for salaries, etc.

SECTION 1. The sums hereinafter mentioned are appropriated, to be paid out of the treasury of the Commonwealth from the ordinary revenue, to meet the expenses of the Massachusetts highway commission for the year eighteen hundred and ninety-nine, to wit :—

For salaries of the Massachusetts highway commission, six thousand dollars.

For salaries of engineers, clerks and assistants in the office of the Massachusetts highway commission, a sum not exceeding seventeen thousand and sixty dollars.

For travelling and other expenses of the commissioners, printing, postage, and necessary office expenses, a sum not exceeding five thousand four hundred and forty dollars.

SECTION 2. This act shall take effect upon its passage.

Approved May 12, 1899.

[ACTS OF 1899, CHAPTER 396.]

AN ACT RELATIVE TO THE CONSTRUCTION AND REPAIR OF
STATE HIGHWAYS.

Be it enacted, etc., as follows :

Construction
and repair of
state highways.

SECTION 1. The Massachusetts highway commission is hereby authorized to expend a sum not exceeding five hundred thousand dollars for the construction and repair of state highways. Of this sum twelve thousand dollars shall be expended in the purchase of such machinery as may be deemed necessary for the construction and repair of state or town roads, and the highway commission may

allow said road machinery to be used by town authorities in the construction or repair of town roads at such times and on such conditions as may be agreed upon; and one hundred thousand dollars shall be reserved for expenses incurred after the first day of January in the year nineteen hundred.

SECTION 2. No persons except citizens of this Commonwealth shall be employed on the work authorized by this act.

Only citizens of the Commonwealth to be employed.

SECTION 3. For the purpose of meeting the expenditure hereby authorized the treasurer and receiver-general is hereby empowered, with the approval of the governor and council, to issue scrip or certificates of indebtedness to an amount not exceeding five hundred thousand dollars, for a term not exceeding thirty years. Such scrip or certificates of indebtedness shall be issued as registered bonds or with interest coupons attached, and shall bear interest not exceeding four per cent. per annum, payable semi-annually. Such scrip or certificates of indebtedness shall be designated on their face as the State Highway Loan, shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth; and the principal and interest thereof shall be paid at the times specified therein in gold coin of the United States or its equivalent. Said scrip or certificates of indebtedness shall be sold and disposed of at public auction, or in such other manner, at such times and prices, in such amounts and at such rates of interest, not exceeding the rate above specified, as shall be deemed best. The sinking fund established by chapter four hundred and ninety-seven of the acts of the year eighteen hundred and ninety-four shall also be maintained for the purpose of providing for the payment of the bonds issued under the authority of this act, and the treasurer and receiver-general shall apportion thereto from year to year an amount sufficient with the accumulations of said fund to extinguish at maturity the debt incurred by the issue of said bonds. The amount necessary to meet the annual sinking fund requirements and to pay the interest on said bonds shall be raised by taxation from year to year.

State Highway Loan.

Sinking fund.

SECTION 4. This act shall take effect upon its passage.

Approved May 24, 1899.

APPENDIX H.

COST PER STANDARD MILE OF ROAD.

TOWN—CITY.	Square Yards of Surfacing.	Miles.	Standard Miles.	COST PER STANDARD MILE OF ROAD, EXCLUSIVE OF BRIDGES. ¹						
				Total.	Macadam or Gravel Surfacing and Shaping.	Same with Telford and Drains.	Same with Gravel.	Same with Excava- tion.	Same with Culverts.	Same with Guard Rail.
Aenshuet,	5,272	.600	.600	\$7,960 38	\$4,585 32	\$5,401 16	\$5,599 50	\$6,282 70	\$6,516 36	\$6,516 36
Adams,	5,000	.568	.568	9,635 73	6,270 41	6,270 41	6,372 55	7,462 00	7,627 34	7,745 80
Andover,	23,108	2.382	2.626	10,455 40	6,027 95	6,339 29	6,688 19	8,562 90	9,006 77	9,294 47
Ashby,	28,469	3.136	3.235	10,787 85	4,723 36	4,992 68	4,987 97	8,870 75	9,242 41	9,625 47
Ashfield, ²	19,815	1.608	1.608	16,520 02	—	589 98	589 98	9,418 03	12,434 07	13,202 11
Athol,	16,033	1.608	1.822	9,029 14	7,045 17	7,166 57	7,204 99	7,807 90	8,141 65	8,279 08
Auburn,	27,773	3.065	3.156	11,230 06	5,827 75	6,339 41	7,171 73	8,525 47	9,689 98	10,012 13
Barnstable,	16,095	1.700	1.821	7,179 24	4,036 46	4,888 13	4,978 96	5,613 12	6,017 35	6,218 50
Barre,	11,208	1.271	1.271	10,149 17	5,307 78	5,728 79	6,147 67	7,368 92	8,304 09	8,790 87
Bedford,	4,787	.543	.543	9,966 59	5,302 02	6,125 17	6,286 31	7,801 23	8,150 98	8,351 51
Beverly,	21,228	2.009	2.412	8,101 03	6,253 02	6,617 45	6,804 22	7,848 42	7,359 86	7,372 90
Blackstone,	5,500	.625	.625	8,131 00	3,661 94	3,561 94	4,363 57	5,396 80	6,975 55	6,975 55
Bourne,	12,460	1.415	1.415	7,755 97	5,025 16	5,833 00	5,510 31	6,382 96	6,667 70	6,620 14
Buxborough,	12,000	1.364	1.364	6,999 40	3,555 96	3,855 86	3,928 07	5,400 36	5,883 35	5,965 83

	21,500	2,443	2,443	8,611 98	5,618 14	5,712 23	6,400 20	7,368 36	7,649 73	7,668 31
Brewster, .	.	.	.	.	.	.	.	.	.	.
Brimfield, ¹	10,267	1,167	1,167	4,964 94	1,410 10	1,468 27	1,468 27	2,602 20	3,102 12	3,335 91
Brimfield, ²	10,308	1,171	1,171	8,065 68	748 28	748 28	748 28	4,900 46	6,266 61	6,338 35
Brockton, .	17,628	1,867	1,902	8,626 50	4,583 04	4,689 30	4,809 78	6,863 15	7,841 86	7,375 30
Brookfield, .	7,783	.884	.884	12,090 04	5,866 17	6,766 36	7,062 78	9,524 09	9,884 96	9,387 55
Buckland, .	25,450	2,898	2,892	11,832 00	6,434 84	6,980 50	7,398 30	9,464 12	9,959 45	10,379 43
Charlemonit, .	7,404	.767	.841	13,336 68	6,070 41	8,124 29	8,870 03	9,776 46	10,838 28	11,013 19
Chatham, .	4,761	.590	.539	6,320 22	4,106 86	4,301 29	4,301 29	4,863 48	5,167 34	5,167 34
Chelmsford, .	9,816	.980	1,115	8,671 88	6,377 57	6,453 72	6,995 06	7,363 04	7,601 16	7,801 16
Chester, .	2,963	.836	.336	9,837 44	5,391 08	5,391 08	5,391 08	6,387 50	7,031 19	8,041 97
Chilcopee, .	10,770	.918	1,324	13,461 43	6,280 68	7,769 13	8,810 21	10,371 73	10,826 96	10,346 48
Cohasset, .	7,917	.900	.900	7,572 74	3,976 11	4,027 89	4,261 22	5,967 23	6,223 83	6,332 23
Cohrain, ²	9,465	1,076	1,076	5,575 27	2,003 67	2,439 87	2,489 87	3,807 52	4,491 26	4,571 56
Concord, .	12,865	1,462	1,462	7,331 06	4,688 03	4,886 59	4,985 30	5,640 50	6,163 57	6,339 00
Cottage City, .	20,856	2,370	2,370	8,674 00	6,680 21	6,680 21	6,721 22	7,335 10	7,423 83	7,735 94
Dalton, .	13,789	1,567	1,567	12,265 03	7,424 44	8,569 03	8,854 77	10,333 00	11,156 07	11,156 07
Dartmouth, .	13,760	1,302	1,663	6,131 54	3,980 86	4,080 96	4,030 96	5,139 39	5,295 32	5,247 06
Deerfield, .	13,436	1,533	1,533	11,749 78	7,475 40	8,144 61	9,060 48	10,578 26	10,875 25	11,061 53
Dennis, .	37,524	4,260	4,260	6,394 22	4,339 24	4,425 02	4,437 84	5,224 78	5,387 60	5,635 68
Duxbury, .	18,083	2,065	2,065	7,184 81	4,683 93	4,704 23	4,859 85	5,642 53	5,821 16	6,029 43
Edgartown, .	2,842	.323	.323	10,578 86	7,970 06	7,970 06	7,970 06	8,200 00	8,200 00	8,200 00
Easthampton, .	11,306	1,265	1,265	12,202 41	6,197 22	7,069 65	9,114 16	10,560 05	10,868 80	11,065 81

* Gravel roads.

* Graded only.

* Compiled from all roads completed Dec. 31, 1899.

COST PER STANDARD MILE OF ROAD — Continued.

TOWN — CITY.	Square Yards of Surfacing.	Miles.	Standard Miles.	COST PER STANDARD MILE OF ROAD, EXCLUSIVE OF BRIDGES. ¹						
				Total.	Macadam or Gravel Surfacing and Shaping.	Same with Telford and Drains.	Same with Gravel.	Same with Excava- tion.	Same with Culverts.	Same with Guard Rail.
Fairhaven,	12,760	1.450	1.450	\$7,084 90	\$4,162 83	\$5,114 82	\$5,613 72	\$5,973 31	\$6,000 00	\$6,135 17
Fitchburg,	14,191	1.579	1.612	12,420 65	6,265 57	6,701 05	7,145 22	10,241 62	10,448 75	10,784 86
Gardner, ²	29,209	2.371	2.371	5,811 86	-	163 43	176 98	3,664 34	4,466 11	4,670 88
Gloucester,	21,862	2.484	2.484	12,408 19	4,667 03	5,000 16	5,209 82	9,939 05	10,474 08	10,795 57
Goshen,	16,780	1.906	1.906	20,287 48	7,190 81	11,505 09	13,088 82	17,408 10	18,433 46	18,906 39
Grafton,	6,917	.786	.786	7,631 51	4,790 09	4,790 09	4,949 11	5,633 37	6,152 10	6,353 24
Granby,	5,631	.634	.634	17,678 20	9,337 44	11,482 96	14,167 82	15,760 57	16,120 97	16,669 56
Great Barrington,	16,449	1.778	1.868	7,873 87	5,531 63	5,651 82	5,651 82	6,421 84	6,903 96	6,922 82
Great Barrington, ³	9,343	1.062	1.062	18,094 72	1,146 42	2,466 46	2,466 46	14,265 90	14,335 12	15,454 61
Greenfield,	6,200	.687	.705	11,089 64	3,551 06	4,991 91	6,174 18	7,473 03	9,437 44	9,487 80
Hadley,	19,662	2.234	2.234	12,343 41	7,035 25	7,510 33	7,982 37	11,013 92	11,068 92	11,371 84
Hancock, ²	19,795	2.249	2.249	11,612 31	983 77	2,040 77	2,040 77	7,082 04	9,014 89	10,232 41
Hardwick, etc.,	7,383	.901	.901	8,630 52	4,594 11	4,982 57	4,999 77	6,135 51	7,036 86	7,145 95
Harwich,	5,833	.663	.663	5,548 08	4,235 97	4,540 27	4,540 27	4,721 11	4,721 11	4,721 11
Hingham,	10,887	1.237	1.237	7,568 40	4,054 43	4,137 82	4,496 01	6,071 46	6,565 17	6,644 70
Hingham, ²	10,509	1.421	1.421	4,305 66	-	-	-	-	-	-
Holbrook,	11,914	1.390	1.390	9,570 66	3,194 04	3,450 66	3,845 07	6,499 33	7,132 47	7,647 55
Holden,	23,534	3.161	3.242	8,270 35	4,320 85	5,094 54	5,749 25	6,532 78	7,144 66	7,295 45

Huntington,	8,929	1.014	1.014	15,028 55	6,552 46	6,700 73	7,806 21	10,080 67	10,789 74	11,269 53
Lawrence,	2,815	.287	.280	6,480 31	4,083 43	4,083 43	4,083 43	5,555 00	5,535 00	5,535 43
Lee, . . .	18,812	1.994	2.081	11,220 99	7,085 24	7,095 77	8,106 39	9,129 26	9,023 71	9,761 97
Lester, . .	42,874	4.186	4.815	13,040 29	5,257 32	5,559 39	9,466 30	10,902 45	11,785 75	11,880 89
Lexington,	30,836	3.444	3.444	9,547 74	4,738 43	5,122 00	5,392 73	6,528 22	7,492 39	7,751 89
Lincoln, . .	18,125	2.089	2.069	7,946 83	5,030 06	5,408 88	5,432 24	6,528 22	6,790 84	6,943 90
Lowell, . . .	22,021	2.804	2.570	8,265 28	5,797 39	6,049 22	6,656 30	6,972 87	7,004 31	7,004 31
Lunenburg,	9,177	1.044	1.044	8,496 15	4,793 37	5,135 84	5,253 83	6,066 09	7,126 08	7,308 26
Marion, . . .	25,126	2.855	2.855	7,940 91	4,722 87	4,513 27	5,645 84	6,405 35	6,774 60	6,928 01
Marlborough,	10,003	1.137	1.137	10,137 90	4,410 30	4,761 91	5,101 23	5,109 06	5,606 90	5,818 08
Marshfield,	17,683	1.998	1.998	8,280 07	4,673 72	4,769 87	5,241 54	6,725 67	6,999 66	7,102 45
Mattapoisett,	10,227	1.162	1.162	6,728 59	3,742 77	4,053 17	4,493 08	4,961 84	5,237 60	5,415 06
Merrimac, . .	8,004	.916	.916	12,309 70	5,104 77	6,299 89	7,643 24	9,930 00	10,319 06	10,495 83
Methuen, . .	9,131	1.033	1.033	7,108 76	4,441 81	4,507 99	4,898 30	5,547 40	5,848 56	6,045 56
Middleborough,	24,285	2.769	2.769	7,545 96	4,527 93	4,549 80	4,699 02	5,085 90	6,290 64	6,457 41
Monson, . . .	9,218	.934	.934	8,155 56	5,706 00	5,931 96	6,233 97	7,083 75	7,330 29	7,469 59
Montague, . .	9,618	1.063	1.063	7,398 08	5,670 54	5,670 54	5,670 54	6,594 24	6,594 24	6,594 24
Nantucket, . .	37,209	4.464	4.233	9,746 00	5,923 93	6,929 83	7,892 55	8,798 74	8,623 10	8,837 28
New Braintree (see Hardwick),	-	-	-	-	-	-	-	-	-	-
Newburyport, . .	15,432	1.754	1.754	7,461 86	4,265 64	4,098 95	4,776 91	6,096 65	6,392 18	6,422 47
Norfolk, . . .	12,723	1.446	1.446	11,343 84	4,637 74	5,055 23	6,714 90	8,121 26	9,131 20	9,991 62
North Adams, . .	14,855	1.688	1.688	9,600 40	7,866 56	7,983 23	8,339 45	8,458 08	8,597 91	8,893 76

† Compiled from all roads completed Dec. 31, 1900.

‡ Gravel roads.

COST PER STANDARD MILE OF ROAD — Continued.

TOWN — CITY.	Square Yards of Surfacing.	Miles.	Standard Miles.	COST PER STANDARD MILE OF ROAD, EXCLUSIVE OF BRIDGES. ¹						
				Total.	Macadam or Gravel Surfacing and Shaping.	Same with Telford and Drains.	Same with Gravel.	Same with Excava- tion.	Same with Culverts.	Same with Guard Rail.
Northampton,	11,958	1.226	1.369	\$12,114 86	\$5,274 90	\$6,314 64	\$7,028 48	\$9,989 55	\$10,689 10	\$10,769 45
North Attleborough,	15,418	1.666	1.751	5,737 57	3,990 69	4,157 96	4,382 12	5,043 11	5,157 00	5,325 07
North Attleborough, ²	17,000	1.932	1.932	6,170 18	2,070 34	2,409 73	2,409 73	4,652 38	5,103 62	5,269 30
Northborough,	11,998	1.364	1.364	8,542 45	3,722 80	3,974 85	4,109 45	6,672 86	7,140 98	7,148 83
North Reading,	8,832	1.009	1.009	8,789 99	4,613 18	4,947 67	4,972 44	6,698 71	7,066 89	7,542 71
Norwood,	13,955	1.583	1.583	9,485 92	5,104 91	6,269 33	7,175 56	7,981 08	8,466 58	8,529 25
Orange,	21,677	2.183	2.463	10,666 80	8,207 38	8,345 96	8,574 42	9,381 68	9,557 69	9,673 86
Palmer,	6,600	.738	.738	8,328 28	3,495 39	3,526 82	3,903 25	5,820 46	7,332 11	7,832 11
Paxton,	28,529	3.242	3.242	13,805 45	5,189 48	8,319 77	9,353 54	11,247 03	12,011 72	12,213 66
Phillipston,	9,280	1.193	1.065	12,679 33	4,798 74	5,365 78	5,486 92	8,831 75	10,217 25	10,525 21
Pittsfield,	13,675	1.543	1.543	12,675 24	6,297 92	7,370 44	7,841 73	10,125 10	10,668 57	10,832 08
Pittsfield, ³	6,734	.765	.765	4,430 19	1,730 19	1,819 74	1,819 74	3,120 78	3,444 76	3,580 77
Plymouth,	22,254	2.529	2.529	12,047 77	5,416 55	6,017 31	6,090 27	9,209 29	9,519 41	9,760 49
Plymouth, ³	16,304	1.823	1.323	2,631 36	-	-	-	1,620 25	1,875 81	2,107 48
Princeton,	4,336	.493	.493	10,445 24	4,401 62	5,078 28	6,425 21	7,316 11	8,545 64	8,978 50
Rehoboth,	13,667	1.553	1.553	9,479 26	4,597 31	4,919 12	4,919 12	7,517 44	8,166 32	8,621 44
Revere,	8,122	.577	.923	32,844 22	7,904 01	9,026 12	11,216 20	19,957 42	20,045 18	20,820 69
Richmond, ³	11,964	1.362	1.362	11,671 73	1,478 74	4,076 35	4,276 17	9,580 02	9,899 42	10,369 89

Russell,	2,309	2,309	20,468 25	6,682 56	6,973 49	8,467 86	13,900 82	15,172 28	15,740 88
Russell, ^s	2,341	2,341	8,831 69	943 54	1,227 76	1,227 76	6,472 16	6,826 48	7,366 90
Sandwich,	1,833	1,833	8,670 60	4,736 51	4,736 51	4,736 51	6,832 18	6,969 13	7,164 44
Satuate,	1,164	1,164	9,368 58	6,333 90	6,666 02	6,766 77	7,766 70	8,009 19	8,026 86
Shelburne,	2,163	2,163	10,339 84	4,923 86	5,429 54	5,494 19	6,379 60	7,566 82	7,870 06
Shrewsbury,	2,964	2,964	9,041 37	5,266 62	5,997 46	6,738 68	7,707 79	7,968 16	8,136 11
Somerset,	2,052	2,052	8,071 98	4,874 53	5,074 77	5,414 76	6,201 56	6,864 60	6,864 84
South Hadley,	1,492	1,492	9,306 30	6,903 55	6,960 40	7,166 30	7,941 40	8,166 42	8,182 16
Sterling,	1,296	1,296	8,944 29	4,972 86	5,042 43	5,202 93	6,766 12	7,463 04	7,780 00
Stoneham,	509	509	12,668 71	5,678 91	5,617 05	6,113 86	10,506 46	10,747 80	10,747 80
Sturbridge,	586	586	11,016 66	4,031 06	6,971 60	7,610 30	8,569 28	9,206 80	9,264 53
Sturbury,	965	965	9,620 56	4,884 87	5,213 33	5,381 97	7,077 51	7,766 00	7,840 93
Sunderland,	188	188	14,319 96	7,739 89	10,006 92	11,714 36	12,076 53	13,233 83	13,968 62
Sutton,	492	492	8,784 34	4,546 52	4,864 02	5,129 36	6,311 58	7,263 13	7,362 43
Swampecott, ^s	1,032	1,032	13,406 70	1,187 98	2,760 67	2,760 67	8,908 66	11,869 60	11,624 08
Taunton,	1,794	1,794	8,546 66	5,414 66	5,692 43	6,349 48	7,316 32	7,694 24	7,793 20
Templeton,	626	626	9,618 88	6,014 01	7,908 31	7,908 31	7,964 00	8,524 90	8,523 12
Tisbury,	1,923	1,923	7,977 49	4,626 06	4,897 51	4,897 51	6,423 60	6,423 60	6,633 40
Townsend,	1,853	1,853	6,613 16	4,331 13	4,438 90	4,454 77	5,437 66	5,707 77	5,828 37
Truro,	1,269	1,269	9,900 67	2,860 40	2,860 40	2,860 40	7,144 90	7,144 90	7,319 26
Tyngsboro,	2,942	2,942	9,009 21	7,263 30	7,337 26	8,136 39	8,133 06	8,317 60	8,327 46
Uxbridge,	1,272	1,272	9,686 06	4,624 84	4,912 42	5,496 93	7,060 63	7,921 77	8,182 94

Graded only.

Gravel roads.

Compiled from all roads completed Dec. 31, 1899.

COST PER STANDARD MILE OF ROAD — Continued.

TOWN — CITY.	Square Yards of Surfacing.	Miles.	Standard Miles.	COST PER STANDARD MILE OF ROAD, EXCLUSIVE OF BRIDGES. ¹					
				Total.	Macadam or Gravel Surfacing and Shaping.	Same with Telford and Drains.	Same with Gravel.	Same with Excava- tion.	Same with Culverts.
Walpole,	32,261	3.666	3.666	\$9,768 90	\$5,000 00	\$5,725 55	\$5,995 80	\$7,988 54	\$8,510 80
Ware (see Hardwick),	-	-	-	-	-	-	-	-	-
Wareham,	14,238	1.618	1.618	7,598 20	5,071 88	5,116 19	5,329 78	6,597 09	6,630 22
Warren,	16,630	1.890	1.890	9,629 62	5,807 40	6,497 88	6,960 31	7,429 62	8,084 12
Watertown,	13,457	.850	1.329	8,546 10	7,065 66	7,296 01	7,383 91	7,736 82	7,922 30
Wayland,	5,333	.607	.607	9,528 83	5,384 51	6,961 61	7,204 76	8,037 66	8,222 40
Wenham,	5,425	.605	.616	10,383 11	6,612 66	6,686 52	6,856 52	7,993 18	8,556 16
Westborough,	10,000	1.136	1.136	11,158 27	4,469 36	5,496 39	6,708 98	8,992 78	9,370 77
West Boylston, ²	13,698	1.553	1.553	7,933 35	2,962 68	3,805 07	4,250 29	5,207 92	6,592 27
West Brookfield,	3,833	.456	.456	13,269 26	5,761 92	7,854 81	8,445 96	9,971 10	11,219 26
Westfield,	33,975	3.471	3.861	7,147 03	4,639 15	5,042 83	6,229 25	6,241 46	6,310 72
Westminster,	26,335	2.992	2.992	11,850 43	5,361 70	5,716 71	6,085 56	8,161 90	9,481 08
West Newbury,	19,673	2.235	2.235	10,983 40	5,546 89	7,651 18	8,789 00	9,601 54	9,832 04
Westport,	44,918	4.256	5.104	7,730 01	4,973 43	6,319 90	5,636 36	6,708 12	7,046 66
Weston,	33,288	3.152	3.783	4,065 18	3,152 68	3,488 65	3,488 65	3,488 65	3,517 20
West Springfield,	12,180	1.153	1.384	7,720 73	4,890 95	5,874 49	6,282 87	6,908 45	7,003 03
West Tisbury,	19,464	2.861	2.212	8,286 43	6,078 48	6,125 58	6,200 81	7,339 87	7,339 87
Weymouth,	16,428	1.749	1.867	8,604 39	6,040 43	6,155 75	6,434 92	7,400 91	7,602 62
Worcester,	32,261	3.666	3.666	\$9,768 90	\$5,000 00	\$5,725 55	\$5,995 80	\$7,988 54	\$8,510 80
Worcester,	14,238	1.618	1.618	7,598 20	5,071 88	5,116 19	5,329 78	6,597 09	6,630 22
Worcester,	16,630	1.890	1.890	9,629 62	5,807 40	6,497 88	6,960 31	7,429 62	8,084 12
Worcester,	13,457	.850	1.329	8,546 10	7,065 66	7,296 01	7,383 91	7,736 82	7,922 30
Worcester,	5,333	.607	.607	9,528 83	5,384 51	6,961 61	7,204 76	8,037 66	8,222 40
Worcester,	5,425	.605	.616	10,383 11	6,612 66	6,686 52	6,856 52	7,993 18	8,556 16
Worcester,	10,000	1.136	1.136	11,158 27	4,469 36	5,496 39	6,708 98	8,992 78	9,370 77
Worcester,	13,698	1.553	1.553	7,933 35	2,962 68	3,805 07	4,250 29	5,207 92	6,592 27
Worcester,	3,833	.456	.456	13,269 26	5,761 92	7,854 81	8,445 96	9,971 10	11,219 26
Worcester,	33,975	3.471	3.861	7,147 03	4,639 15	5,042 83	6,229 25	6,241 46	6,310 72
Worcester,	26,335	2.992	2.992	11,850 43	5,361 70	5,716 71	6,085 56	8,161 90	9,481 08
Worcester,	19,673	2.235	2.235	10,983 40	5,546 89	7,651 18	8,789 00	9,601 54	9,832 04
Worcester,	44,918	4.256	5.104	7,730 01	4,973 43	6,319 90	5,636 36	6,708 12	7,046 66
Worcester,	33,288	3.152	3.783	4,065 18	3,152 68	3,488 65	3,488 65	3,488 65	3,517 20
Worcester,	12,180	1.153	1.384	7,720 73	4,890 95	5,874 49	6,282 87	6,908 45	7,003 03
Worcester,	19,464	2.861	2.212	8,286 43	6,078 48	6,125 58	6,200 81	7,339 87	7,339 87
Worcester,	16,428	1.749	1.867	8,604 39	6,040 43	6,155 75	6,434 92	7,400 91	7,602 62

Whitman,	17,822	1,697	2,025	11,551 48	6,576 79	6,977 33	8,340 64	10,086 32	10,757 38	10,777 62
Wilbraham,	16,781	1,907	1,907	9,900 31	6,984 55	7,281 06	7,618 32	8,589 35	8,596 06	8,776 23
Williamsburg,	5,106	.587	.587	15,946 84	6,000 00	8,574 11	8,574 11	12,971 55	13,747 80	13,981 68
Williamsburg, ²	14,085	1,143	1,143	11,995 62	-	1,167 89	1,442 08	6,439 68	9,738 14	10,238 84
Williamstown,	16,916	1,922	1,922	13,000 26	6,924 14	8,520 86	10,065 96	11,949 68	12,364 00	12,847 13
Winchester,	8,867	.765	1,007	4,871 30	2,807 54	3,026 71	3,528 23	3,808 44	4,083 94	4,081 92
Windsor, ⁴	2,501	.284	.284	12,516 54	1,323 23	2,088 38	2,610 91	6,157 74	7,520 07	7,904 92
Worcester,	17,758	2,016	2,016	12,065 22	4,412 15	6,516 12	7,068 13	8,454 16	10,219 46	10,536 90
Wrentham,	26,582	3,021	3,021	8,849 65	4,648 56	4,804 26	5,384 90	7,200 16	7,062 07	7,708 24
Yarmouth,	77,422	8,798	8,798	7,486 79	5,544 95	5,721 53	6,043 27	6,686 35	6,778 33	6,840 50
Totals,	2,171,036	237,237	245,890	-	-	-	-	-	-	-
Average, all,	-	-	-	\$9,829 78	\$4,526 12	\$5,435 54	\$5,842 79	\$7,571 04	\$8,192 99	\$8,390 90
Average, graded only,	-	8,648	8,648	9,720 04	322 71	906 54	944 46	5,827 73	7,096 54	8,080 23
Average, gravel roads,	-	15,212	16,212	8,736 05	1,459 52	2,165 67	2,091 81	5,631 69	6,440 99	6,807 83
Average, macadam roads,	-	213,377	220,085	9,931 23	5,338 55	5,939 40	6,391 51	7,904 96	8,371 13	8,545 13

¹ Compiled from all roads completed Dec. 31, 1899.² 6,800 feet gravel, 1,400 feet macadam.³ Graded only.⁴ Gravel roads.

COST PER STANDARD MILE OF ROAD—*Concluded.**Sections laid out and constructed during 1899.*

TOWN—CITY.	Square Yards.	Miles.	Standard Miles.	Cost per Standard Mile.
Andover,	6,063	.691	.691	\$7,075 11
Ashby,	3,839	.435	.435	9,385 72
Auburn,	6,049	.698	.698	12,097 67
Barnstable,	8,833	.947	.947	6,824 71
Barre,	5,897	.600	.600	10,393 83
Blackstone,	5,500	.625	.625	8,131 00
Boxborough,	5,533	.607	.607	6,393 40
Brimfield, ¹	10,306	1.171	1.171	8,065 68
Brockton, ²	6,406	.692	.728	9,844 35
Buckland, ³	2,528	.369	.287	9,382 33
Charlestown, ⁴	1,156	.131	.131	10,361 14
Chelmsford, ⁴	9,816	.990	1.116	8,671 83
Chatham, ⁵	1,751	.248	.198	6,799 49
Chatham, ⁵	3,000	.341	.341	6,041 93
Chester,	2,958	.317	.317	10,448 26
Cohasset,	3,751	.426	.426	6,024 65
Dartmouth, ⁴	13,750	1.302	1.563	6,131 54
Duxbury,	6,105	.694	.694	5,886 81
Gardner, ⁵	14,530	1.651	1.651	10,038 85
Grafton,	4,250	.483	.483	10,251 97
Great Barrington, ⁵	6,533	.777	.777	7,549 60
Greenfield, ⁴	6,300	.587	.705	11,089 64
Harwich,	5,833	.663	.663	5,548 03
Lunenburg,	5,285	.613	.613	8,745 51
Marion,	7,167	.814	.814	6,002 27
Marshfield,	4,821	.548	.548	6,474 08
Nantucket, ⁵	2,800	.307	.318	8,074 52
North Attleborough, ¹	3,188	.381	.381	7,606 13
Palmer,	6,500	.738	.738	8,326 28
Plymouth, ⁵	9,680	1.100	1.100	8,040 00
Richmond, ⁴	2,928	.332	.332	11,943 67
Somerset, ⁴	7,490	.701	.841	6,101 52
South Hadley,	5,868	.667	.667	7,162 17
Sutton,	4,332	.492	.492	8,734 34
Taunton,	2,967	.337	.337	11,708 56
Templeton,	5,500	.625	.625	9,618 88
Townsend,	6,418	.729	.729	5,914 54
West Brookfield,	3,533	.436	.436	13,269 26
Westfield, ⁶	9,429	1.052	1.072	6,683 00
Westminster,	2,660	.302	.302	16,910 92
Weston, ⁴	33,288	3.152	3.783	4,065 18
Winchester, ⁷	8,860	.755	1.007	4,871 30
Total,	272,630	29.526	30.978	\$8,403 00 ^a
Gravel,	16,421	1.884	1.884	9,202 49 ^a
Macadam,	256,209	27.642	29.094	8,357 10 ^a

¹ Gravel road.² Macadam, 16 feet in width.³ Macadam, 12 feet in width.⁴ Macadam, 18 feet in width.⁵ Represents cost of macadamizing in 1899, plus cost of grading in previous years.⁶ 525 feet of macadam, 18 feet in width.⁷ Macadam, 20 feet in width.^a Average cost per mile.

APPENDIX I.

MAINTENANCE.

Table showing the Amounts expended for Repairs and Maintenance and the Cost per Mile per Year on Each Road finished previous to 1900.

TOWN OR CITY.	Expended. 1896.	Expended. 1897.	Expended. 1898.	Expended. 1899.	Total.	Total Cost per Mile per Year.	Remarks.
Acushnet,	-	-	\$41 44	\$528 60	\$570 04	\$456 03	1,000 feet resurfaced; 850 feet of drains laid.
Adams,	-	-	7 63	86 38	94 01	104 45	
Andover,	\$3 50	\$10 57	46 16	173 57	233 80	45 84	
Ashby,	45 75	78 59	163 79	1,292 15	1,580 28	173 66	800 feet of side drains relaid; repairing horse path, 1894 lay-out; 150 tons of stone stacked for repairs.
Ashfield,	-	-	4 65	138 40	143 05	77 74	
Athol,	-	1,134 39	2,664 16	239 80	4,068 35	824 26	Excessive cost largely due to the reconstruction of retaining wall constructed by town; 85 tons of stone stacked for repairs.
Anbourn,	-	154 87	134 70	167 48	457 05	75 42	
Barnstable,	-	-	57 05	99 98	157 03	100 66	30 tons of stone stacked for repairs.
Barre,	-	-	6 47	25 04	31 51	21 01	10 tons of stone stacked for repairs.
Bedford,	-	-	7 61	16 59	24 20	26 39	
Beverly,	-	73 75	182 32	261 08	523 15	98 89	Macadam, 18 feet wide; very heavy travel.
Bourne,	-	-	98 92	48 46	142 38	91 86	
Borborough,	-	-	4 29	15 05	19 34	12 32	

Table showing the Amounts expended for Repairs and Maintenance, etc. — Continued.

TOWN OR CITY.	Expended. 1896.	Expended. 1897.	Expended. 1898.	Expended. 1899.	Total.	Total Cost per Mile per Year.	Remarks.
Brewster,	-	\$150 36	\$500 88	\$206 76	\$857 90	\$123 97	Includes repairs on 410 feet of road washed out by storm of Nov. 24, 1898.
Brimfield,	-	-	7 33	25 63	32 96	21 13	
Brookton,	-	-	24 25	15 38	39 63	25 70	
Brookfield,	-	-	1 60	15 36	16 96	15 85	
Buckland,	-	95 82	21 99	198 13	315 94	48 16	800 feet of macadam, 34 feet wide; 1,400 feet of macadam, 18 feet wide.
Charlemont,	-	-	51 90	53 80	110 70	119 03	Very heavy loads of iron ore pass frequently over this road; 36 tons of stone stacked for repairs.
Chatham,	-	-	-	6 62	6 62	37 53	
Chelmsford,	-	-	-	17 21	17 21	36 03	
Chilcopee,	-	-	-	204 45	204 45	152 53	Clay wash from brick yards has to be removed frequently.
Cohasset,	-	-	2 61	77 65	80 26	97 83	
Colrain,	-	-	-	55 93	55 93	-	50 cubic yards of screened gravel stacked for repairs.
Concord,	-	-	7 55	134 20	141 75	62 17	100 tons of stone stacked for repairs.
Cottage City,	\$15 00	449 15	632 73	630 89	1,771 27	202 83	This road is exposed to high winds, which carry off binder and make its maintenance costly; Jetty extended this season.
Dalton,	-	369 71	519 45	343 44	1,232 30	256 26	
Dartmouth,	-	-	-	197 10	197 10	-	230 tons of stone stacked for repairs.
Deerfield,	105 00	97 57	73 72	530 14	806 43	156 59	A portion of the surface was resurfaced; 50 tons of stone stacked for repairs.
Dennis,	-	251 54	563 13	273 41	1,092 08	120 94	210 tons of stone stacked for repairs.
Duxbury,	178 24	85 06	59 66	93 35	416 31	80 68	
Easthampton,	-	83 14	171 89	151 53	411 56	84 86	
Edgartown,	-	-	19 03	98 96	112 99	171 20	Jetty built.

Fairhaven,	.	.	.	8 73	97 45	75 92	182 10	29 52	
Fitchburg,	.	.	.	33 09	106 73	188 58	328 40	66 96	
Gardner,	.	.	.	-	77 38	229 38	306 76	91 08	30 tons of stone stacked for repairs.
Gloucester,	.	.	.	47 00	137 13	348 11	537 88	90 44	
Goshen,	.	.	.	-	628 88	88 73	1,374 02	182 47	Mountain road, cost due largely to sliding clay slopes and expense of keeping gutters clear; 86 tons of stone stacked for repairs.
Grafton,	.	.	.	-	10 34	69 65	69 99	42 42	
Granby,	.	.	.	268 16	19 62	68 11	477 42	174 88	Due largely to "horse tracks;" stone costly; 36 tons of stone stacked for repairs.
Great Barrington,	.	.	.	-	382 36	438 67	996 92	124 46	Screenings placed on part of the road; frost.
Hadley,	.	.	.	561 78	315 19	268 60	1,913 78	303 26	High cost due to repairs to "horse tracks."
Hancock,	.	.	.	93 10	722 89	519 15	1,393 32	245 74	Gravel surface put on 1895 lay-out; slopes slide badly on 1896 lay-out.
Hardwick,	.	.	.	-	10 34	67 16	77 50	92 26	Hardwick and New Braintree.
Hingham,	.	.	.	108 10	101 05	130 50	462 53	61 25	
Holbrook,	.	.	.	-	25 97	120 49	173 61	67 87	190 tons of stone stacked for repairs.
Holbrook (Weymouth),	.	.	.	-	14 50	-	67 43		
Holden,	.	.	.	224 25	17 08	120 82	666 77	66 21	2,100 feet macadam, 18 feet wide.
Huntington,	.	.	.	-	24 07	144 04	475 67	168 24	Blindrap and rough wall constructed where washed by river in spring of 1897; repairs to "horse tracks."
Lawrence,	.	.	.	-	9 65	14 40	24 05	37 00	Macadam, 18 feet wide.
Lee,	.	.	.	10 00	418 83	692 08	1,177 73	151 97	750 feet of macadam, 18 feet wide; 1,000 feet of slide drains constructed.
Leicester,	.	.	.	351 46	2,211 80	493 24	4,146 61	413 43	Macadam, 24 feet wide, resurfaced with trap rock for 3,000 feet; 7,660 feet macadam, 18 feet wide.
Lexington,	.	.	.	-	8 58	143 60	338 02	42 79	100 tons of stone stacked for repairs.
Lincoln,	.	.	.	21 08	86 42	97 87	237 73	39 62	
Lowell (North),	.	.	.	-	13 44	179 18	192 62	71 01	
Lowell (South),	.	.	.	-	11 36	94 26	105 62		

Table showing the Amounts expended for Repairs and Maintenance, etc. — Continued.

TOWN OR CITY.	Expended 1898.	Expended. 1897.	Expended. 1898.	Expended. 1899.	Total.	Total Cost per Mile per Year.	Remarks.
Lanesburg,	-	-	-	\$13 94	\$13 94	\$34 45	
Marion,	-	\$23 51	\$119 31	121 51	264 03	37 43	
Marlborough,	-	-	7 14	86 90	93 74	93 91	
Marshfield,	\$3 50	18 25	141 03	80 80	244 23	63 77	
Mattapoisett,	3 83	6 98	63 85	99 02	179 23	36 29	
Merrimac,	-	-	3 52	25 02	28 54	21 95	
Methuen,	-	-	44 59	77 37	121 86	54 16	
Middleborough,	-	87 06	187 25	126 88	401 19	47 42	
Monson,	-	150 79	196 43	159 76	506 98	133 77	760 feet of 4-inch clay pipe purchased for drains.
Montague,	-	-	-	179 49	179 49	131 98	Expense largely due to repairs to "horse tracks."
Nantucket,	10 83	693 27	172 33	635 71	1,512 74	109 06	Stone very expensive; 200 tons of stone stacked for repairs.
New Braintree,	-	-	-	-	-	98 00	See Hardwick.
Newburyport,	-	6 86	43 34	204 81	255 01	109 92	80 tons of stone stacked for repairs.
Norfolk,	-	22 41	99 96	160 02	282 09	56 40	
North Adams,	56 56	52 16	309 87	133 45	602 04	101 52	
Northampton,	133 70	37 65	77 19	14 56	263 10	72 66	Road is heavily travelled and stone is soft.
North Attleborough,	-	65 81	203 32	35 65	305 28	29 41	
Northborough,	-	-	6 02	38 04	45 26	25 00	
North Reading,	-	-	3 14	59 36	62 50	57 87	
Norwood,	27 70	3 63	135 04	94 90	261 32	56 72	

Orange,	623 91	74 47	266 76	964 14	157 28	A large part of expense was due to a so-called "cloud-burst" in 1897.
Paxton,	729 98	133 88	192 73	1,111 25	103 37	50 tons of stone stacked for repairs.
Phillipston,	-	61 90	109 40	161 30	145 31	50 tons of stone stacked for repairs; heavy washout in spring.
Pittsfield (East),	-	3 70	107 41	111 11	92 50	Gravel road.
Pittsfield (West),	162 62	224 33	398 70	780 84	138 20	Bridge replanked this season.
Plymouth,	131 60	502 93	635 90	1,440 44	135 00	200 tons of stone stacked for repairs.
Princeton,	-	5 86	15 87	21 72	20 49	
Rehoboth,	-	74 56	316 06	399 95	90 08	
Revere,	-	9 19	193 75	202 94	273 00	
Richmond,	-	62 77	42 98	95 75	87 84	Gravel road.
Russell,	673 10	190 96	371 65	1,764 88	127 89	
Sandwich,	-	317 24	440 66	757 90	297 23	Greater portion of expense due to storm of Nov. 26, 1893; 100 tons of stone stacked for repairs.
Selma,	-	45 96	159 95	379 89	115 82	
Shelburne,	84 50	164 22	286 13	710 27	96 24	3,920 feet macadam, 18 feet wide.
Shrewsbury,	-	28 43	123 09	432 22	60 28	1 mile macadam, 18 feet wide.
Somerset,	-	5 18	108 24	352 25	59 40	1,400 feet macadam, 18 feet wide; 96 tons of stone stacked for repairs.
South Hadley,	-	123 75	320 01	695 73	221 11	90 tons of stone stacked for repairs; repairs of "horse tracks" costly.
Sterling,	-	50	84 07	34 57	23 74	
Stoneham,	-	173 51	57 00	280 51	217 45	50 tons of stone stacked for repairs.
Sturbridge,	-	58 68	11 85	70 53	79 25	50 tons of stone stacked for repairs.
Sudbury,	-	2 61	23 11	30 72	35 72	50 tons of stone stacked for repairs.
Sunderland,	-	1 18	5 75	6 98	24 75	
Swampscott,	-	6 43	200 21	206 69	190 23	

Table showing the Amounts expended for Repairs and Maintenance, etc. — Concluded.

TOWN OR CITY.	Expended. 1896.	Expended. 1897.	Expended. 1898.	Total. 1899.	Total Cost per Mile per Year.	Remarks.
Taunton,	\$235 45	\$372 83	\$145 75	\$653 12	\$188 09	Stone of poor quality; "horse tracks" badly; 12 tons of stone stacked for repairs.
Templeton,	-	-	-	3 85	18 33	
Tisbury,	18 84	208 59	225 10	653 13	78 42	
Townsend,	-	3 92	7 07	55 41	18 29	25 tons of stone stacked for repairs.
Turo,	-	14 22	14 86	181 17	45 39	
Tynsborough,	-	43 91	184 58	602 78	81 68	
Uxbridge,	-	-	-	47 46	41 68	
Walpole,	15 00	29 70	277 95	646 59	73 81	155 tons of stone stacked for repairs.
Ware,	-	-	6 33	41 17	53 14	
Wareham,	-	8 43	19 98	154 45	45 03	
Warren,	-	6 15	75 71	314 71	84 15	
Watertown,	-	73 49	169 91	513 51	186 06	Macadam, 83 feet wide; 25 tons of stone stacked for repairs.
Wayland,	-	-	3 80	22 70	24 67	
Wenham,	-	-	27 66	98 42	77 50	
Westborough,	-	-	4 49	47 43	40 54	
West Boylston,	-	-	-	48 75	27 89	
Westfield,	980 38	11 08	55 37	1,382 92	148 70	Macadam, 18 feet wide; replanking Westfield River bridge and washout at Frog Hole bridge greatly increased maintenance cost.
Westminster,	7 50	50 49	287 19	450 38	67 92	
West Newbury,	-	355 82	440 95	1,200 41	207 65	Slopes slide badly at Pipe Slave Hill; 50 tons of stone stacked for repairs.
Weston,	-	-	-	97 75	-	80 tons of stone stacked for repairs.

Westport, . . .	182 96	182 45	1,333 09	1,698 50	183 10	Macadam, 18 feet wide; 1,200 feet resurfaced; 1,000 feet of side drain constructed.
West Springfield, . .	171 66	198 84	95 01	465 51	127 89	Macadam, 18 feet wide.
West Tisbury, . . .	90 87	123 11	150 93	364 91	49 45	Macadam, 18 feet, 15 feet and 12 feet wide; 400 tons of stone stacked.
Weymouth, . . .	212 47	108 57	198 11	519 15	110 93	85 tons of stone stacked.
Whitman, . . .	43 72	104 26	51 75	199 73	31 35	Macadam, 18 feet wide.
Wilbraham, . . .	222 10	337 13	113 22	672 50	120 74	Repairs expensive because of "horse tracks;" 20 tons of stone stacked for repairs.
Williamsburg, . . .	3 49	58 97	185 92	243 38	143 57	100 tons of stone stacked for repairs.
Williamstown, . . .	20 42	148 09	193 33	361 84	88 25	
Windsor, . . .	-	1 79	14 70	16 49	47 11	
Worcester (Paxton), .	21 02	385 94	123 37	535 33	125 96	48 feet 24-inch iron pipe culvert constructed, with 112 feet 12-inch clay pipe outlet, this season.
Wrentham, . . .	68 50	162 13	284 47	573 36	67 15	50 tons of stone stacked for repairs.
Yarmouth (North), . .	-	340 45	262 85	711 74	57 82	25 tons of stone stacked for repairs.
Yarmouth (South), . .	-	398 05	550 80	1,229 17	93 19	
Totals, . . .	\$4,727 19	\$13,266 93	\$24,333 24	\$63,193 55	-	

APPENDIX K.

STATEMENT SHOWING ALL PETITIONS RECEIVED,
WITH LENGTHS OF WAY PETITIONED FOR, AND
LAY-OUTS MADE, TOGETHER WITH SUMMARY BY
COUNTIES.*Barnstable County.*

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-98.		1899.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Barnstable, ^{1,3} . . .	125	July 31, 1895,	10,548	2.00	-	-	-	-
Barnstable, ^{2,3} . . .	231	Feb. 13, 1896,	10,560	2.00	4,452	.84	-	-
Barnstable, ^{1,4} . . .	418	Apr. 23, 1898,	9,625	1.82	-	-	5,000	.95
Bourne, ⁵	124	Jan. 29, 1895,	16,128	3.05	-	-	-	-
Bourne, ⁵	338	May 1, 1897,	7,470	1.42	7,470	1.42	-	-
Bourne, ⁷	445	Dec. 19, 1898,	27,000	5.11	-	-	-	-
Brewster,	118	Jan. 15, 1895,	40,982	7.76	13,117	2.49	-	-
Chatham,	155	Apr. 4, 1895,	10,639	2.01	-	-	3,114	.59
Dennis, ¹	102	Nov. 27, 1894,	22,500	4.27	22,511	4.27	-	-
Dennis, ⁵	126	Feb. 6, 1895,	17,225	3.26	-	-	-	-
Eastham,	209	Aug. 5, 1895,	34,144	6.47	-	-	-	-
Harwich,	106	Dec. 22, 1894,	26,150	4.95	-	-	4,700	.89
Orleans, ¹	182	May 27, 1895,	10,440	1.98	-	-	-	-
Orleans, ⁵	479	Dec. 14, 1899,	13,725	2.60	-	-	-	-
Provincetown,	186	June 4, 1895,	14,790	2.80	-	-	-	-
Sandwich, ¹	98	Nov. 23, 1894,	9,000	1.70	9,000	1.70	-	-
Sandwich, ¹	430	July 15, 1895,	6,382	1.21	676	.13	-	-
Truro, ⁹	95	Oct. 22, 1894,	12,478	2.36	12,478	2.36	-	-
Truro, ¹⁰	386	Dec. 1, 1897,	20,503	3.88	-	-	-	-
Wellfleet,	229	Jan. 30, 1896,	10,203	1.93	-	-	-	-
Yarmouth, ¹	90	Sept. 28, 1894,	19,634	3.72	19,585	3.71	-	-
Yarmouth, ³	100	Nov. 26, 1894,	26,900	5.10	26,825	5.08	-	-
Totals,			377,023	71.41	116,114	21.99	12,814	2.43

Twenty-two petitions, in thirteen towns.

Average distance petitioned for, 17,137 feet (3.25 miles).

Thirty-one lay-outs, in nine towns; all on town petitions.

Distance laid out, 128,928 feet (24.42 miles); average, 4,159 feet (.79 mile).

Percentage of length laid out to length petitioned for, 34.19.

¹ North county road.³ South county road.⁵ Plymouth line to Sandwich line.⁷ Bourne Village to Sandwich line.⁹ Wellfleet line to Kelly's Corner.² From Yarmouth line.⁴ From Sandwich line.⁶ Bourne Village to Wareham line.⁸ Chatham road.¹⁰ North Truro to Kelly's Corner.

Berkshire County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles	1894-96.		1899.	
Adams, ^{1,2}	45	July 18, 1894,	9,600	1.82	-	-	-	-
Adams, ³	279	July 30, 1895,	5,280	1.00	3,600	.57	-	-
Adams, ⁴	376	Oct. 16, 1897,	12,552	2.38	-	-	-	-
Becket, ⁵	117	Jan. 12, 1895,	10,560	2.00	-	-	-	-
Becket, ⁶	440	Dec. 16, 1896,	53,430	10.12	-	-	-	-
Berkshire County, ⁷	46	July 18, 1894,	12,288	2.33	-	-	-	-
Berkshire County, ⁸	47	July 18, 1894,	9,015	1.71	8,913	1.69	-	-
Berkshire County, ⁹	82	Aug. 13, 1894,	10,560	2.00	10,560	2.00	-	-
Berkshire County, ¹⁰	83	Aug. 13, 1894,	5,200	.99	5,188	.98	-	-
Berkshire County, ¹¹	170	May 10, 1896,	6,289	1.19	6,200	1.18	-	-
Berkshire County, ¹²	187	June 6, 1896,	5,300	1.00	5,292	1.00	-	-
Berkshire County, ¹³	275	July 25, 1896,	5,280	1.00	-	-	-	-
Berkshire County, ¹⁴	276	July 25, 1896,	5,280	1.00	-	-	-	-
Berkshire County, ¹⁵	277	July 25, 1896,	5,280	1.00	-	-	-	-
Berkshire County, ¹⁶	278	July 25, 1896,	5,280	1.00	-	-	-	-
Berkshire County, ¹⁷	283	Sept. 21, 1896,	10,015	1.90	5,627	1.06	-	-
Berkshire County, ¹⁸	330	Mar. 9, 1897,	2,574	.48	-	-	-	-
Berkshire County, ¹⁹	415	Apr. 7, 1898,	6,146	1.16	-	-	-	-
Berkshire County, ²⁰	434	Oct. 5, 1898,	12,900	2.44	-	-	-	-
Berkshire County, ²¹	435	Oct. 5, 1898,	5,280	1.00	154	.03	-	-
Berkshire County, ²²	462	Apr. 17, 1899,	12,000	2.38	-	-	-	-
Cheshire, ^{23,24}	46	-	3,382	.64	-	-	-	-
Cheshire, ²⁵	331	Mar. 11, 1897,	5,260	1.00	-	-	4,991	.95
Cheshire, ^{26,1}	410	Dec. 16, 1899,	34,300	6.50	-	-	-	-
Clarksburg,	431	July 26, 1898,	5,280	1.00	-	-	-	-
Dalton, ²⁷	26	June 10, 1894,	12,696	2.40	-	-	-	-
Dalton, ²⁸	176	May 14, 1895,	6,314	1.20	5,459	1.03	-	-
Dalton, ²⁹	238	Apr. 1, 1896,	6,290	1.19	2,800	.53	-	-
Dalton, ³⁰	313	Jan. 29, 1897,	3,200	.63	-	-	-	-
Dalton, ³¹	340	May 18, 1897,	5,450	1.04	-	-	-	-
Florida,	74	Aug. 1, 1894,	26,853	5.09	-	-	-	-
Great Barrington, ^{32,33}	82	-	10,560	2.00	10,560	2.00	-	-
Great Barrington, ^{34,35}	267	June 18, 1896,	10,284	1.95	4,146	.79	-	-
Hancock, ³⁶	170	-	6,289	1.19	6,200	1.18	-	-
Hancock, ³⁷	293	-	10,015	1.90	5,627	1.06	2,615	.50
Hancock, ³⁸	330	-	2,574	.49	-	-	2,574	.49
Hinsdale,	156	Apr. 6, 1895,	5,624	1.07	-	-	-	-
Lee, ^{39,40}	83	-	5,200	.99	5,188	.98	-	-
Lee, ^{41,42}	187	-	5,300	1.00	5,292	1.00	-	-

¹ Duplicate of county petition.² Cheshire-Savoy road.³ Maple Grove road.⁴ North Adams road.⁵ Pittsfield-Springfield road.⁶ See Adams.⁷ See North Adams.⁸ See Great Barrington.⁹ See Lee.¹⁰ See Hancock.¹¹ See Otis.¹² See Savoy.¹³ See Cheshire.¹⁴ See Lanesborough.¹⁵ See West Stockbridge.¹⁶ See Richmond.¹⁷ See Tyringham.¹⁸ See Williamstown.¹⁹ On county petition.²⁰ Pittsfield-North Adams road.²¹ Pittsfield-Northampton road.²² Monterey road.

Berkshire County—Concluded.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-95.		1899.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Lee, ¹	252	May 25, 1896,	5,280	1.00	-	-	-	-
Lee, ²	248	June 14, 1897,	6,702	1.28	-	-	-	-
Lenox, ³	178	May 16, 1895,	5,280	1.00	-	-	4,700	.89
Lenox, ³	316	Feb. 7, 1897,	6,770	1.28	-	-	-	-
Lanesborough, ⁴	278	-	5,280	1.00	-	-	-	-
Monterey,	256	June 5, 1896,	5,280	1.00	-	-	-	-
Mount Washington,	92	Oct. 1, 1894,	8,300	1.58	-	-	-	-
North Adams, ⁴	47	-	9,018	1.71	3,913	1.69	-	-
North Adams, ⁵	254	May 27, 1896,	5,807	1.10	-	-	-	-
North Adams, ⁶	393	Dec. 22, 1897,	12,436	2.36	-	-	-	-
Otis, ⁴	275	-	5,280	1.00	-	-	-	-
Pittsfield, ⁷	78	Aug. 7, 1894,	24,087	4.56	3,145	1.54	-	-
Pittsfield, ⁸	259	June 10, 1896,	6,000	1.13	4,040	.76	-	-
Richmond, ⁹	198	June 4, 1895,	10,462	1.98	-	-	-	-
Richmond, ¹⁰	248	May 9, 1896,	5,280	1.00	5,280	1.00	-	-
Richmond, ⁹	434	-	12,900	2.44	156	.03	1,755	.33
Sandisfield,	459	Mar. 13, 1899,	5,280	1.00	-	-	-	-
Savoy, ⁴	276	-	5,280	1.00	-	-	-	-
Stockbridge,	186	Feb. 26, 1895,	10,700	2.02	-	-	-	-
Tyringham, ⁴	435	-	5,280	1.00	-	-	-	-
West Stockbridge,	166	Sept. 30, 1895,	6,146	1.16	-	-	-	-
Williamstown, ¹¹	145	Mar. 10, 1895,	10,576	2.00	10,147	1.92	-	-
Williamstown, ^{12, 13}	462	Apr. 29, 1899,	12,600	2.38	-	-	-	-
Windsor,	86	July 12, 1894,	42,787	8.10	1,501	.28	-	-
Totals,			463,044	87.70	86,454	16.37	16,635	3.15

Forty-nine petitions (sixteen county, five city and twenty-eight town), in two cities and twenty-three towns.

Average distance petitioned for, 9,450 feet (1.79 miles).

Thirty-one lay-outs, in two cities and ten towns.

Laid out on county petitions, 48,880 feet (9.26 miles).

Laid out on city petitions, 12,185 feet (2.31 miles).

Laid out on town petitions, 42,024 feet (6.12 miles).

Total length laid out, 103,089 feet (19.52 miles); average, 3,325 feet (.63 mile).

Percentage of length laid out to distance petitioned for, 22.26.

¹ South Lee road.

² Lenox road.

³ Lee road.

⁴ On county petition.

⁵ Williamstown road.

⁶ Pittsfield-North Adams road.

⁷ Hancock-Lebanon Springs road.

⁸ Dalton road.

⁹ Hancock road.

¹⁰ East road to Pittsfield.

¹¹ North Adams road.

¹² Water Street.

¹³ Duplicate of county petition.

Bristol County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-95.		1899.	
					Feet.	Miles.	Feet.	Miles.
Acushnet, ¹	96	Oct. 24, 1894,	35,500	6.73	3,363	.64	-	-
Acushnet, ²	97	Oct. 24, 1894,	6,326	1.20	-	-	-	-
Attleborough, ³	183	May 29, 1895,	14,153	2.68	-	-	-	-
Attleborough, ⁴	184	May 29, 1895,	5,112	.97	-	-	-	-
Attleborough, ⁵	268	June 18, 1896,	14,246	2.70	-	-	-	-
Berkley,	281	Aug. 3, 1896,	22,650	4.29	-	-	-	-
Bristol County, ⁶	58	July 24, 1894,	48,070	9.11	25,434	4.81	3,900	.74
Dartmouth, ⁷	22	July 9, 1894,	24,000	4.55	2,975	.56	3,900	.74
Dighton, ⁸	150	Mar. 26, 1895,	24,576	4.65	-	-	-	-
Dighton, ⁹	226	Jan. 2, 1896,	8,261	1.56	-	-	-	-
Easton, ¹⁰	139	Mar. 1, 1895,	39,000	7.39	-	-	-	-
Easton, ¹¹	365	Sept. 2, 1897,	4,300	.81	-	-	-	-
Fairhaven,	31	July 10, 1894,	20,100	3.80	7,653	1.45	-	-
Freetown,	314	Feb. 3, 1897,	16,850	3.20	-	-	-	-
Mansfield,	341	Apr. 8, 1897,	5,121	.97	-	-	-	-
New Bedford,	191	June 18, 1895,	2,950	.56	-	-	-	-
North Attleborough,	18	July 5, 1894,	25,550	4.83	16,979	3.21	2,013	.38
Raynham,	134	Feb. 23, 1895,	23,000	4.36	-	-	-	-
Rehoboth, ⁹	132	Feb. 20, 1895,	29,187	5.53	8,193	1.55	1,800	.34
Rehoboth, ¹²	476	June 19, 1899,	9,240	1.75	-	-	-	-
Seekonk,	127	Feb. 6, 1895,	14,591	2.76	-	-	-	-
Somerset,	147	Mar. 30, 1895,	29,800	5.64	10,330	2.05	3,700	.70
Swansea,	235	Mar. 10, 1896,	36,515	6.92	-	-	-	-
Taunton, ^{9,13}	171	May 11, 1895,	25,864	4.89	-	-	-	-
Taunton, ^{9,14}	179	May 16, 1895,	23,762	4.50	9,470	1.80	1,780	.34
Taunton, ^{10,15}	180	May 19, 1895,	13,200	2.50	-	-	-	-
Westport, ¹⁶	53	-	24,070	4.56	22,459	4.25	-	-
Totals,	.	.	491,584	93.10	81,922	15.51	13,193	2.50

Twenty-six petitions (one county, four city and twenty-one town), in two cities and sixteen towns.

Average distance petitioned for, 18,906 feet (3.60 miles).

Twenty-seven lay-outs, in one city and seven towns.

Laid out on county petition, 29,334 feet (5.66 miles).

Laid out on city petitions, 11,250 feet (2.13 miles).

Laid out on town petitions, 54,531 feet (10.32 miles).

Total length laid out, 95,115 feet (18.01 miles); average, 3,523 feet (.67 mile).

Percentage of length laid out to length petitioned for, 19.35.

¹ New Bedford-Boston road.

² Washington Street (turnpike).

³ Washington and Horton streets.

⁷ Duplicate of county petition.

⁹ Taunton-Providence road.

¹¹ Brockton-Mansfield road.

¹³ Somerset Avenue and Dean Street.

¹⁵ Broadway.

² Fairhaven road.

⁴ North Avenue.

⁶ See Dartmouth and Westport.

⁸ Taunton-Fall River road.

¹⁰ Taunton-Boston road.

¹² Town House road.

¹⁴ Winthrop Street.

¹⁶ On county petition.

Dukes County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-98.		1899.	
					Feet.	Miles.	Feet.	Miles.
Ohlmark, . . .	12	July 3, 1894,	41,237	7.81	-	-	-	-
Cottage City, ¹ . . .	7	- -	13,117	2.48	12,538	2.37	-	-
Cottage City, ¹ . . .	335	- -	2,150	.41	-	-	-	-
Dukes County, ² . . .	7	July 2, 1894,	26,217	4.96	12,538	2.37	1,551	.29
Dukes County, ³ . . .	335	Mar. 27, 1897,	6,919	1.31	-	-	-	-
Edgartown, ¹ . . .	7	- -	13,100	2.48	1,705	.33	-	-
Tisbury, . . .	3	June 28, 1894,	10,600	2.01	10,194	1.93	-	-
Tisbury, ¹ . . .	335	- -	4,769	.90	-	-	-	-
West Tisbury, . . .	4	June 28, 1894,	28,441	5.39	15,000	2.84	-	-
West Tisbury, ⁴ . . .	244	May 29, 1896,	6,912	1.18	-	-	-	-
Totals, . . .	.	.	119,635	22.66	39,437	7.47	1,551	.29

Six petitions (two county, four town), in five towns.

Average distance petitioned for, 19,939 feet (3.78 miles).

Nine lay-outs, in four towns.

Laid out on county petitions, 15,794 feet (2.99 miles).

Laid out on town petitions, 25,194 feet (4.77 miles).

Total length laid out, 40,988 feet (7.76 miles).

Percentage of length laid out to length petitioned for, 34.26.

¹ On county petition.

² See Cottage City and Tisbury.

³ See Cottage City and Edgartown.

⁴ Petition for change of location.

Essex County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-95.		1899.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Amesbury, . . .	203	July 22, 1895,	27,997	5.30	-	-	2,674	.51
Andover, ¹ . . .	20	July 6, 1894,	31,400	5.95	8,936	1.70	3,650	.69
Andover, ^{2,3} . . .	436	- -	21,750	4.12	-	-	-	-
Andover, ⁴ . . .	442	Dec. 18, 1898,	25,080	4.75	-	-	-	-
Andover, ^{5,6} . . .	443	Dec. 18, 1898,	21,750	4.12	-	-	-	-
Beverly, ⁷ . . .	64	- -	13,900	2.64	10,613	2.01	-	-
Boxford, . . .	395	Dec. 23, 1897,	25,125	4.76	-	-	-	-
Danvers, . . .	351	June 29, 1897,	6,267	1.18	-	-	-	-
Essex, . . .	364	Aug. 8, 1897,	22,412	4.24	-	-	-	-
Essex County, ⁸ . . .	64	July 30, 1894,	53,800	10.19	13,307	2.62	3,490	.66
Essex County, ⁹ . . .	436	Oct. 26, 1898,	29,670	5.64	-	-	-	-
Georgetown, . . .	390	Dec. 16, 1897,	16,800	3.18	-	-	-	-
Gloucester, ¹⁰ . . .	28	July 10, 1894,	9,650	1.83	9,650	1.83	-	-
Gloucester, ¹¹ . . .	110	Jan. 1, 1895,	54,120	10.25	-	-	-	-
Gloucester, ¹² . . .	380	Apr. 5, 1897,	8,528	1.62	3,446	.65	-	-
Groveland, . . .	211	Aug. 8, 1896,	23,948	4.53	-	-	-	-
Hamilton, ¹³ . . .	64	- -	18,100	3.43	-	-	3,490	.66
Haverhill, . . .	297	Nov. 4, 1896,	13,888	2.68	-	-	10,964	2.08
Haverhill, . . .	471	June 1, 1899,	15,840	3.00	-	-	-	-
Ipswich, ^{14,15} . . .	64	- -	12,700	2.40	-	-	-	-
Ipswich, ¹⁶ . . .	239	Apr. 4, 1896,	11,900	2.25	-	-	-	-
Lawrence, ¹⁷ . . .	76	Aug. 2, 1894,	2,640	.50	-	-	-	-
Lawrence, ¹⁸ . . .	245	May 4, 1896,	4,660	.88	-	-	-	-
Lawrence, ¹⁹ . . .	284	Aug. 26, 1896,	2,300	.44	-	-	-	-
Lawrence, ²⁰ . . .	285	Aug. 25, 1896,	1,750	.33	-	-	-	-
Lawrence, ²¹ . . .	290	Sept. 11, 1896,	1,408	.27	1,408	.27	-	-
Lawrence, ^{22,23} . . .	436	- -	7,920	1.50	-	-	-	-
Lawrence, ²⁴ . . .	460	Mar. 16, 1899,	1,800	.34	-	-	-	-

¹ Boston-Lawrence road.² Lowell-Lawrence road.³ Duplicate of county petition.⁴ See Lawrence and Andover.⁵ See Lawrence and Andover.⁶ Essex Avenue, Washington Street and Rockport road.⁷ South of arch bridge, Boston-Newburyport road.⁸ North of arch bridge, Boston-Newburyport road.⁹ Haverhill Street.¹⁰ Prospect Street.¹¹ Lowell road, south.¹² On county petition.¹³ Tewksbury road to Frye Village.¹⁴ See Beverly, Wenham, Hamilton and Ipswich.¹⁵ Western Avenue.¹⁶ South Broadway.¹⁷ Jackson Street.¹⁸ Loring Street to North Andover.

Essex County—Concluded.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-98.		1899.	
					Feet.	Miles.	Feet.	Miles.
Lynn,	342	May 20, 1897,	9,120	1.73	-	-	4,777	.90
Manchester, . . .	167	May 1, 1898,	5,280	1.00	-	-	-	-
Merrimac,	204	July 26, 1896,	15,134	2.87	4,547	.86	291	.06
Methuen, ¹	287	Aug. 31, 1896,	20,184	3.82	5,478	1.04	-	-
Methuen, ²	387	Dec. 8, 1897,	5,280	1.00	-	-	-	-
Middleton,	347	July 12, 1897,	26,501	5.02	-	-	-	-
Newbury, ³	197	July 2, 1895,	22,388	4.24	-	-	2,750	.52
Newbury, ⁴	410	Mar. 7, 1898,	23,133	4.38	-	-	-	-
Newburyport, ⁵ . .	196	July 1, 1895,	10,100	1.91	9,259	1.75	-	-
Newburyport, ⁴ . .	417	Apr. 22, 1898,	2,700	.51	-	-	-	-
North Andover, . .	274	July 1, 1896,	10,186	1.93	-	-	-	-
Peabody, ⁶	352	July 1, 1897,	5,380	1.02	-	-	-	-
Peabody, ⁷	353	July 1, 1897,	12,120	2.30	-	-	-	-
Rockport,	185	Feb. 23, 1896,	5,786	1.08	-	-	-	-
Rowley,	242	Apr. 23, 1896,	19,280	3.65	-	-	-	-
Salem,	474	June 18, 1899,	700	.13	-	-	-	-
Salisbury, ⁸	243	Apr. 27, 1896,	10,560	2.00	-	-	-	-
Salisbury, ⁹	405	Feb. 11, 1898,	11,500	2.18	-	-	-	-
Saugus,	34	July 11, 1894,	8,811	1.67	8,444	1.60	-	-
Swampscott,	375	Oct. 14, 1897,	8,780	1.66	5,449	1.03	-	-
Topsfield,	383	Nov. 27, 1897,	26,031	4.95	-	-	-	-
Wenham,	64	-	9,100	1.73	3,194	.61	-	-
West Newbury, ⁵ . .	101	Nov. 26, 1894,	27,017	5.11	11,781	2.22	-	-
West Newbury, ¹⁰ . .	206	July 25, 1895,	4,000	.76	-	-	-	-
Totals,			680,904	128.96	82,155	15.56	28,596	5.42

Forty-six petitions (two county, fifteen city and twenty-nine town), in seven cities and twenty-four towns.

Average distance petitioned for, 14,802 feet (2.80 miles).

Thirty-one lay-outs in six cities and ten towns.

Laid out on county petitions, 17,297 feet (3.28 miles).

Laid out on city petitions, 39,504 feet (7.48 miles).

Laid out on town petitions, 53,950 feet (10.22 miles).

Total length laid out, 110,751 feet (20.98 miles); average, 8,673 feet (.68 mile).

Percentage of length laid out to distance petitioned for, 16.27.

¹ Haverhill road.

² Lowell road.

³ Boston-Newburyport road, *via* Oldtown. ⁴ Boston-Newburyport road, *via* Turnpike.

⁵ Newburyport-Haverhill road.

⁶ From Lynn line, Washington and Lynn streets.

⁷ From Danvers line, Sylvan and Andover streets.

⁸ Newburyport road.

⁹ Haverhill road.

¹⁰ Proposed relocation at Pipe Stave Hill.

Franklin County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR		LENGTH LAID OUT.			
			Feet.	Miles.	1894-95.		1895.	
					Feet.	Miles.	Feet.	Miles.
Ashfield, ¹	195	June 26, 1895.	5,300	1.00	-	-	-	-
Ashfield, ²	367	Sept. 18, 1897.	8,900	1.70	8,492	1.61	-	-
Ashfield, ¹	454	Jan. 10, 1899.	5,200	.99	-	-	-	-
Ashfield, ¹	464	May 1, 1899.	5,280	1.00	-	-	-	-
Buckland, ^{3,4}	88	July 14, 1894.	1,152	.22	796	.15	-	-
Buckland, ⁴	112	Jan. 5, 1896.	5,280	1.00	5,308	1.01	-	-
Buckland, ⁴	224	Dec. 28, 1895.	5,280	1.00	5,328	1.01	-	-
Buckland, ⁴	315	Feb. 15, 1896.	5,274	1.00	1,924	.36	1,896	.36
Buckland, ⁴	468	Mar. 9, 1899.	17,160	3.25	-	-	-	-
Charlemont, ⁵	120	Jan. 18, 1895.	7,500	1.42	3,866	.64	-	-
Charlemont, ¹	450	Dec. 24, 1898.	24,820	6.50	-	-	693	.13
Colrain, ^{1,8}	43	July 17, 1894.	1,062	.20	-	-	-	-
Colrain, ¹	133	Feb. 20, 1895.	12,438	2.36	5,679	1.08	-	-
Colrain, ¹	432	Aug. 2, 1898.	17,060	3.23	-	-	-	-
Conway, ¹	215	Sept. 4, 1895.	14,147	2.68	-	-	-	-
Deerfield, ^{6,7}	24	-	9,400	1.79	8,093	1.53	-	-
Deerfield, ⁸	329	Mar. 10, 1897.	37,248	7.06	-	-	-	-
Erving,	152	Mar. 29, 1895.	10,717	2.03	4,213	.80	2,225	.42
Franklin County, ⁹	24	July 9, 1894.	69,170	13.10	37,036	7.02	2,225	.42
Gill,	130	Feb. 7, 1895.	10,520	1.99	-	-	-	-
Greenfield, ¹⁰	188	June 10, 1895.	23,700	4.49	-	-	-	-
Greenfield, ¹¹	382	Mar. 23, 1897.	6,722	1.27	-	-	3,100	.59
Greenfield, ¹²	897	Dec. 23, 1897.	5,300	1.00	-	-	-	-
Greenfield, ¹³	456	Feb. 2, 1899.	4,680	.89	-	-	-	-
Greenfield, ¹⁴	457	Feb. 2, 1899.	8,550	1.62	-	-	-	-
Montague, ¹⁵	304	Dec. 18, 1896.	10,660	2.00	-	-	-	-
Montague, ¹⁶	359	July 11, 1897.	6,587	1.25	5,761	1.09	-	-
Montague, ¹⁷	860	July 11, 1897.	8,305	1.57	-	-	-	-
Montague, ¹⁸	453	Jan. 3, 1899.	4,000	.76	-	-	2,855	.54
New Salem,	258	June 8, 1896.	27,329	5.18	-	-	-	-
Northfield,	422	June 8, 1898.	15,840	3.00	-	-	-	-
Orange, ³	6	July 2, 1894.	30,550	5.74	11,544	2.19	-	-
Orange, ³	103	Dec. 10, 1894.	5,280	1.00	-	-	-	-
Orange, ³	301	Nov. 27, 1896.	2,300	.43	-	-	-	-
Shelburne, ¹⁹	35	July 11, 1894.	12,188	2.30	11,398	2.16	-	-
Shelburne, ²⁰	227	Jan. 13, 1896.	5,280	1.00	-	-	-	-
Sunderland, ³	52	July 24, 1894.	4,151	.80	992	.17	-	-
Sunderland,	402	Jan. 11, 1898.	5,280	1.00	-	-	-	-
Whately, ^{3,21}	325	Feb. 28, 1897.	5,400	1.02	-	-	-	-
Whately, ^{3,22}	408	Feb. 11, 1898.	5,300	1.00	-	-	4,122	.78
Totals,			410,580	77.75	72,891	13.80	14,891	2.82

Thirty-nine petitions (one county and thirty-eight town), in sixteen towns.

Average distance petitioned for, 10,526 feet (1.99 miles).

Thirty-two lay-outs, in twelve towns.

Laid out on county petitions, 39,261 feet (7.44 miles).

Laid out on town petitions, 48,521 feet (9.19 miles).

Total length laid out, 87,782 feet (16.62 miles).

Percentage of length laid out to distance petitioned for, 21.40.

¹ Shelburne Falls road.

² Duplicate of county petition.

³ In part Mine road to Rowe.

⁷ Sunderland road.

⁹ See Buckland, Colrain, Deerfield, Erving,

Orange, Shelburne and Sunderland.

¹¹ Deerfield road.

¹² Turner's Falls road.

¹⁵ Miller's Falls via Ferry road.

¹⁷ Miller's Falls via L Street.

¹⁹ Colrain road.

²¹ From Hatfield line.

³ Relocation.

⁴ Ashfield road.

⁶ On county petition.

⁸ Greenfield-Northampton road.

¹⁰ Bernardston road.

¹³ Shelburne road.

¹⁴ Montague City road.

¹⁶ Miller's Falls via Pipe line.

¹⁸ Third and Prospect streets.

²⁰ Greenfield road.

²² From Deerfield line.

Hampden County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-98.		1899.	
					Feet.	Miles.	Feet.	Miles.
Blandford, ¹ . . .	216	Sept. 7, 1895,	13,377	2.84	-	-	-	-
Blandford, ² . . .	221	Feb. 23, 1897,	13,858	2.63	-	-	-	-
Brimfield, ³ . . .	40	July 6, 1894,	36,370	6.89	6,180	1.17	6,185	1.17
Brimfield, ^{4,5} . . .	131	-	9,355	1.77	-	-	-	-
Chester, ^{6,7} . . .	104	Dec. 11, 1894,	5,280	1.00	-	-	-	-
Chester, ^{6,7} . . .	426	June 23, 1898,	5,535	1.05	-	-	-	-
Chester, ⁸ . . .	441	Dec. 16, 1898,	24,950	6.62	-	-	1,775	.34
Chilcopee, . . .	223	Dec. 28, 1895,	5,700	1.08	4,552	.87	295	.06
East Longmeadow, .	202	July 11, 1895,	25,426	4.81	-	-	-	-
Granville, . . .	87	Sept. 6, 1894,	12,848	2.43	-	-	-	-
Hampden, . . .	201	July 11, 1895,	18,081	3.41	-	-	-	-
Hampden County, ⁹ .	19	July 6, 1894,	100,480	19.03	48,354	9.16	13,232	2.51
Hampden County, ⁹ .	131	Feb. 12, 1895,	90,064	17.06	5,276	1.00	3,600	.68
Hampden County, ¹⁰ .	241	April 23, 1896,	5,708	1.06	-	-	-	-
Hampden County, ¹¹ .	273	July 3, 1896,	5,300	1.00	-	-	-	-
Holyoke, . . .	273	-	5,300	1.00	-	-	-	-
Longmeadow, . . .	383	Mar. 24, 1897,	5,400	1.02	-	-	-	-
Ludlow, . . .	236	Mar. 11, 1896,	14,831	2.80	-	-	-	-
Monson, ¹² . . .	57	July 26, 1894,	14,900	2.83	4,933	.93	-	-
Monson, ^{4,5} . . .	131	-	6,925	1.31	-	-	-	-
Palmer, ⁴ . . .	131	-	46,034	8.72	-	-	3,600	.68
Russell, ⁴ . . .	19	-	35,380	6.70	27,875	5.27	7,314	1.39
Wales, . . .	41	July 16, 1894,	26,925	5.10	-	-	-	-
Westfield, ⁴ . . .	19	-	40,900	7.75	12,435	2.36	5,918	1.12
West Springfield, ¹³ .	118	Jan. 8, 1895,	24,200	5.58	8,054	1.53	-	-
West Springfield, ⁴ .	241	-	5,708	1.06	-	-	-	-
Wilbraham, ⁴ . . .	131	-	27,750	5.26	5,998	1.14	-	-
Wilbraham, ¹⁴ . . .	247	May 8, 1896,	4,140	.78	4,140	.78	-	-
Totals, . . .	.	.	428,368	81.13	74,137	14.04	25,087	4.75

Twenty petitions (four county, one city and fifteen town), in two cities and fifteen towns.

Average distance petitioned for, 21,418 feet (4.06 miles).

Thirty-three lay-outs in one city and eight towns.

Laid out on county petitions, 70,462 feet (13.35 miles).

Laid out on city petitions, 4,847 feet (.92 mile).

Laid out on town petitions, 23,915 feet (4.53 miles).

Total length laid out, 99,224 feet (18.80 miles).

Percentage of length laid out to length petitioned for, 23.15.

¹ Huntington road.

² Russell road.

³ Road to Brimfield Centre and Wales.

⁴ On county petition.

⁵ River road.

⁶ Springfield-Pittsfield road.

⁷ Covered by subsequent petition.

⁸ See Russell, Westfield and West Springfield.

⁹ See Wilbraham, Monson, Palmer and Brimfield.

¹⁰ See West Springfield; Agawam road.

¹¹ Holyoke-Springfield road.

¹² Palmer road.

¹³ Duplicate of county petition.

¹⁴ Relocation.

Hampshire County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1924-25.		1925.	
					Feet.	Miles.	Feet.	Miles.
Amherst,	181	May 18, 1895,	5,356	1.02	-	-	-	-
Belchertown, ¹	220	Nov. 18, 1895,	5,280	1.00	-	-	-	-
Belchertown, ¹	282	Aug. 6, 1896,	5,280	1.00	-	-	-	-
Belchertown, ¹	461	Mar. 16, 1899,	2,640	.60	-	-	-	-
Chesterfield, ²	128	Feb. 6, 1895,	2,067	.68	-	-	-	-
Cummington, ³	27	July 10, 1894,	55,063	10.43	-	-	-	-
Easthampton, ³	114	Jan. 10, 1895,	5,900	1.12	-	-	-	-
Easthampton, ^{2,4}	189	July 10, 1895,	7,475	1.42	6,963	1.32	-	-
Enfield,	283	Aug. 25, 1896,	9,593	1.81	-	-	-	-
Goshen, ³	2	June 28, 1894,	29,480	5.53	10,058	1.91	-	-
Granby, ⁵	5	-	3,347	.63	3,347	.63	-	-
Granby, ^{5,6}	239	Sept. 9, 1896,	10,700	2.03	-	-	-	-
Greenwich,	295	Oct. 17, 1896,	5,464	1.03	-	-	-	-
Hadley, ^{2,4}	94	Oct. 20, 1894,	5,673	1.07	5,676	1.08	-	-
Hadley, ⁴	200	July 11, 1895,	4,133	.78	4,133	.78	-	-
Hadley, ⁴	286	Aug. 27, 1896,	14,749	2.79	2,001	.38	2,584	.49
Hampshire County, ⁷	5	June 29, 1894,	89,195	16.99	43,190	8.18	5,443	1.03
Hatfield, ⁸	165	April 23, 1895,	5,280	1.00	-	-	-	-
Hatfield, ⁹	164	April 23, 1895,	2,500	.47	-	-	-	-
Huntington,	99	Nov. 24, 1894,	14,408	2.73	5,336	1.01	-	-
Middlefield,	177	May 14, 1895,	5,400	1.03	-	-	-	-
Northampton, ^{3,10}	97	July 31, 1894,	2,997	.56	2,997	.56	-	-
Northampton, ^{3,11}	194	June 25, 1895,	8,585	1.63	3,170	.60	1,922	.36
Northampton, ¹²	470	May 27, 1899,	4,500	.85	-	-	-	-
South Hadley, ⁵	5	-	15,571	2.95	7,879	1.49	3,521	.67
South Hadley, ³	238	Sept. 3, 1896,	8,845	1.63	-	-	-	-
Southampton,	253	May 25, 1896,	5,280	1.00	-	-	-	-
Ware, ¹³	205	July 29, 1895,	4,100	.77	1,788	.34	1,794	.34
Ware, ¹³	455	Feb. 2, 1899,	10,300	1.95	-	-	-	-
Williamsburg, ⁵	5	-	31,743	6.01	3,100	.58	-	-
Williamsburg, ^{3,14}	129	Feb. 6, 1895,	11,908	2.26	-	-	-	-
Williamsburg, ^{3,15}	249	May 11, 1896,	5,695	1.08	-	-	-	-
Williamsburg, ¹⁶	411	Mar. 17, 1898,	6,036	1.14	6,036	1.14	-	-
Williamsburg, ^{3,15}	439	Dec. 12, 1898,	4,700	.89	-	-	-	-
Totals,			294,590	56.79	62,484	11.83	9,821	1.86

Thirty-one petitions (one county, three city and twenty-seven town), in one city and seventeen towns.

Average distance petitioned for, 9,508 feet (1.80 miles).

Twenty-seven lay-outs in one city and eight towns.

Laid out on county petitions, 43,633 feet (9.21 miles).

Laid out on city petitions, 2,997 feet (.56 mile).

Laid out on town petitions, 20,675 feet (3.92 miles).

Total length laid out, 72,305 feet (13.69 miles); average, 2,680 feet (.51 mile).

Percentage of length laid out to length petitioned for, 23.21.

¹ Granby road.

² Duplicate of county petition.

³ Holyoke Street.

⁴ Northampton road.

⁵ On county petition.

⁶ Holyoke road.

⁷ See Chesterfield, Cummington, Easthampton, Goshen, Granby, Hadley, Northampton, South Hadley and Williamsburg.

⁸ Road to Hatfield Village.

⁹ North Hatfield road.

¹⁰ Bridge Street.

¹¹ Easthampton road.

¹² Holyoke road via Smith's Ferry.

¹³ Ware-Gilbertville road.

¹⁴ Chesterfield road.

¹⁵ Goshen road.

¹⁶ Relocation.

Middlesex County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-95.		1899.	
					Feet.	Miles.	Feet.	Miles.
Acton, ¹	119	Jan. 7, 1895,	9,158	1.73	-	-	-	-
Acton, ¹	138	Feb. 23, 1895,	12,129	2.30	-	-	-	-
Acton, ^{2,3}	233	-	21,922	4.15	-	-	-	-
Acton, ^{2,4}	413	-	24,500	4.64	-	-	11,100	2.10
Ashby,	1	June 27, 1894,	18,625	3.53	16,538	3.14	2,288	.43
Ashland, ⁵	351	July 24, 1897,	11,843	2.24	-	-	-	-
Ashland, ⁶	362	July 24, 1897,	9,112	1.73	-	-	-	-
Ayer,	225	Jan. 1, 1896,	14,246	2.70	-	-	-	-
Bedford,	175	May 14, 1895,	19,635	3.72	2,872	.54	-	-
Belmont,	343	May 21, 1897,	5,109	.97	-	-	-	-
Billerica,	264	June 13, 1896,	18,490	3.50	-	-	-	-
Boxborough, ^{2,3}	233	-	17,777	3.37	3,591	.68	3,009	.68
Burlington,	336	Apr. 16, 1897,	14,205	2.69	-	-	-	-
Carlisle,	109	Dec. 26, 1894,	26,381	4.99	-	-	-	-
Chelmsford, ^{7,8}	50	July 20, 1894,	5,583	1.06	-	-	-	-
Chelmsford, ^{8,9}	266	-	6,030	1.15	4,347	.82	561	.11
Chelmsford, ⁹	467	May 24, 1899,	6,600	1.25	-	-	-	-
Chelmsford, ¹⁰	468	May 24, 1899,	9,240	1.75	-	-	-	-
Concord, ¹¹	81	Sept. 11, 1894,	10,393	1.97	7,719	1.46	-	-
Concord, ^{4,7}	388	Dec. 7, 1897,	3,800	.72	-	-	-	-
Dracut, ¹²	344	June 3, 1897,	21,373	4.15	-	-	-	-
Dracut, ¹³	473	June 8, 1899,	17,234	3.26	-	-	-	-
Dunstable,	291	Sept. 17, 1896,	8,778	1.66	-	-	-	-
Framingham,	303	Dec. 17, 1896,	3,296	1.57	-	-	-	-
Groton, ¹⁴	105	Dec. 17, 1894,	40,215	7.61	-	-	-	-
Groton, ^{4,7}	219	Nov. 14, 1895,	22,597	4.23	-	-	-	-
Holliston,	363	July 30, 1897,	33,480	6.34	-	-	-	-
Hopkinton,	309	Jan. 6, 1897,	20,440	3.87	-	-	-	-
Hudson,	370	Sept. 25, 1897,	31,057	5.89	-	-	-	-
Lexington, ¹¹	79	Aug. 8, 1894,	18,300	3.46	18,214	3.45	-	-
Lexington, ¹⁵	419	May 14, 1898,	13,200	2.50	-	-	-	-

¹ Littleton road *via* North Acton.² On county petition.³ Southborough road.⁷ Duplicate of county petition.⁹ Tyngsborough road.¹¹ Lexington-Concord road.¹³ River road; new location.¹⁵ Lowell road *via* Chelmsford.² Harvard Turnpike.⁴ Great road.⁶ Pond Street.⁸ Truant School road to Lowell.¹⁰ Billerica road.¹² North road to Methuen.¹⁴ Lowell-Fitchburg road.

Middlesex County—Continued.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-98.		1899.	
					Feet.	Miles.	Feet.	Miles.
Lincoln, ¹	80	Aug. 8, 1894,	10,850	2.05	10,855	2.07	-	-
Lincoln, ²	377	Aug. 30, 1897,	17,800	3.37	-	-	-	-
Littleton, ³	218	Nov. 14, 1895,	12,110	2.29	-	-	-	-
Littleton, ⁴	412	-	10,200	1.93	-	-	-	-
Littleton, ⁴	413	-	27,800	5.26	-	-	-	-
Lowell, ⁴	44	-	5,248	.99	5,115	.97	-	-
Lowell, ⁵	55	July 25, 1894,	7,062	1.34	7,045	1.34	-	-
Lowell, ¹⁰	409	Mar. 9, 1898,	5,800	1.10	-	-	-	-
Marlborough, ¹¹	143	Mar. 15, 1895,	12,868	2.44	3,870	.73	3,363	.64
Marlborough, ¹²	271	June 26, 1896,	17,835	3.33	2,142	.41	-	-
Maynard,	366	Sept. 9, 1897,	11,164	2.11	-	-	-	-
Medford, ⁸	265	June 13, 1896,	4,918	.93	-	-	-	-
Medford, ¹³	446	Dec. 19, 1898,	4,200	.80	-	-	-	-
Middlesex County, ¹⁴	44	July 17, 1894,	20,800	3.94	20,703	3.92	-	-
Middlesex County, ⁹	45	July 17, 1894,	12,645	2.39	7,045	1.34	-	-
Middlesex County, ¹⁵	233	Feb. 25, 1896,	39,099	7.52	3,591	.68	3,609	.68
Middlesex County, ⁹	266	June 15, 1896,	6,030	1.15	4,347	.82	561	.11
Middlesex County, ¹³	274	July 13, 1896,	11,368	2.15	3,006	.57	-	-
Middlesex County, ⁸	412	Feb. 3, 1898,	10,200	1.93	-	-	-	-
Middlesex County, ⁶	413	Feb. 3, 1898,	78,697	14.90	-	-	11,100	2.10
Middlesex County, ²⁰	427	June 25, 1898,	11,088	1.91	-	-	-	-
Natick,	251	May 21, 1896,	6,813	1.29	-	-	-	-
Newton, ²¹	337	Apr. 26, 1897,	780	.15	-	-	-	-
Newton, ²²	477	Nov. 1, 1899,	5,500	1.04	-	-	-	-
North Reading,	107	Dec. 24, 1894,	31,060	5.88	5,329	1.01	-	-
Pepperell,	299	Nov. 11, 1896,	18,700	3.54	-	-	-	-
Reading,	157	Apr. 10, 1895,	23,100	4.38	-	-	4,500	.85
Sherborn,	250	May 14, 1896,	5,500	1.04	-	-	-	-
Shirley,	416	Apr. 21, 1898,	7,400	1.40	-	-	-	-

¹ Lexington-Concord road.³ Littleton Depot to Great road.⁵ Ayer road.⁷ Tyngsborough-Lowell road; boulevard.⁹ Truant School road.¹¹ Northborough road.¹³ Stoneham-Medford road.¹⁵ See Lowell and Chelmsford.¹⁷ See Acton and Boxborough.¹⁹ See Acton, Concord, Littleton and Groton.²¹ At Weston bridge.² South Great road.⁴ On county petition.⁶ Great road.⁸ Duplicate of county petition.¹⁰ First Street to Dracut.¹² Sudbury road.¹⁴ See Lowell and Tyngsborough.¹⁶ Harvard Turnpike.¹⁸ See Medford and Stoneham.²⁰ See Tewksbury.²² Winchester and Needham streets.

Middlesex County — Concluded.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-98.		1899.	
					Feet.	Miles.	Feet.	Miles.
Stoneham, ^{1,2} . . .	230	July 30, 1896,	6,450	1.22	3,006	.67	-	-
Stoneham, ³ . . .	355	July 7, 1897,	3,086	.58	-	-	-	-
Stow, . . .	378	Nov. 1, 1897,	24,215	4.59	-	-	-	-
Sudbury, ³ . . .	214	Aug. 24, 1895,	5,300	1.00	-	-	-	-
Sudbury, ³ . . .	230	Feb. 16, 1896,	20,400	3.87	5,098	.96	-	-
Tewksbury, ⁴ . . .	257	June 5, 1896,	14,770	2.80	-	-	-	-
Tewksbury, ⁴ . . .	357	July 8, 1897,	20,188	3.82	-	-	-	-
Tewksbury, ⁵ . . .	427	-	11,088	1.91	-	-	-	-
Townsend, ⁶ . . .	149	Mar. 21, 1895,	16,830	3.19	9,444	1.78	359	.07
Townsend, ⁶ . . .	466	May 24, 1899,	17,800	3.38	-	-	-	-
Tyngsborough, ^{7,8} . . .	44	-	15,552	2.94	15,588	2.95	-	-
Tyngsborough, ⁹ . . .	444	Dec. 18, 1898,	21,120	4.00	-	-	-	-
Wakefield, ¹⁰ . . .	400	Dec. 29, 1897,	17,979	3.41	-	-	-	-
Wakefield, ¹¹ . . .	469	May 15, 1899,	8,580	1.62	-	-	-	-
Watertown, . . .	151	Mar. 27, 1895,	17,736	3.36	4,472	.85	-	-
Wayland, ³ . . .	212	Aug. 10, 1895,	15,450	2.93	3,206	.61	-	-
Wayland, ¹² . . .	334	Mar. 31, 1897,	11,620	2.20	-	-	-	-
Westford, . . .	115	Jan. 15, 1895,	21,900	4.15	-	-	-	-
Weston, ³ . . .	322	Feb. 24, 1897,	17,509	3.32	6,070	1.26	9,974	1.89
Weston, ¹³ . . .	323	Feb. 24, 1897,	21,269	4.03	-	-	-	-
Wilmington, ¹³ . . .	345	June 10, 1897,	37,682	7.14	-	-	-	-
Wilmington, ⁴ . . .	349	July 22, 1897,	9,918	1.88	-	-	-	-
Winchester, . . .	244	Apr. 28, 1896,	10,760	2.04	-	-	3,987	.76
Woburn, ¹⁴ . . .	448	Dec. 21, 1898,	9,925	1.88	-	-	-	-
Woburn, ¹⁵ . . .	449	Dec. 21, 1898,	19,800	3.75	-	-	-	-
Totals, . . .			1,143,388	216.55	135,151	25.60	39,741	7.53

Seventy-six petitions (eight county, ten city and fifty-eight town), in five cities and forty-two towns.

Average distance petitioned for, 15,176 feet (2.88 miles).

Forty-seven lay-outs, in two cities and eighteen towns.

Laid out on county petitions, 54,962 feet (10.41 miles).

Laid out on city petitions, 21,535 feet (4.08 miles).

Laid out on town petitions, 98,395 feet (18.64 miles).

Total length laid out, 174,892 feet (33.12 miles); average, 3,721 feet (.70 mile).

Percentage of length laid out to distance petitioned for, 15.12.

¹ Duplicate of county petition.

² Boston-Worcester road.

³ Lowell-Lawrence road.

⁴ On county petition.

⁵ Chelmsford road.

⁶ Main and Lowell streets.

⁷ Boston-Lawrence road.

⁸ Main, School, Plain, Washington and Salem streets and Mishawum road.

⁹ Stoneham-Medford road.

¹⁰ Boston-Lowell road.

¹¹ Ashby-Pepperell road.

¹² Tyngsborough-Lowell road; boulevard.

¹³ Railroad and Nahant streets.

¹⁴ Boston-Framingham road.

¹⁵ Cambridge Street.

Nantucket County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-98.		1899.	
					Feet.	Miles.	Feet.	Miles.
Nantucket, . . .	11	July 3, 1894,	34,185	6.47	22,270	4.23	1,320	.25

Eight lay-outs.

Length laid out, 22,590 feet (4.48 miles).

Percentage of length laid out to length petitioned for, 66.01.

Norfolk County.

COUNTY, CITY OR TOWN.	No	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-98.		1899.	
					Feet.	Miles.	Feet.	Miles.
Bellingham, . . .	173	May 13, 1895,	3,900	.74	-	-	-	-
Bellingham, . . .	424	June 22, 1898,	46,730	8.85	-	-	-	-
Braintree, . . .	116	Jan. 10, 1895,	6,700	1.27	-	-	-	-
Cohasset, . . .	158	Apr. 2, 1895,	11,300	2.14	2,200	.41	2,551	.48
Dedham, . . .	307	Dec. 31, 1896,	3,900	.75	-	-	-	-
Foxborough, ¹ . . .	123	Jan. 29, 1895,	23,875	4.52	-	-	-	-
Foxborough, ² . . .	163	Apr. 24, 1895,	5,840	1.11	-	-	-	-
Franklin, . . .	298	Nov. 6, 1896,	9,227	1.75	-	-	-	-
Holbrook, . . .	9	July 10, 1894,	13,140	2.49	5,817	1.11	-	-
Medway, ³ . . .	311	Jan. 18, 1897,	5,535	1.05	-	-	-	-
Medway, ⁴ . . .	368	Sept. 2, 1897,	15,587	2.95	-	-	-	-
Millis, . . .	381	Nov. 12, 1897,	6,265	1.19	-	-	-	-
Milton, . . .	190	June 15, 1895,	5,730	1.09	-	-	2,600	.49
Needham, ⁵ . . .	154	Apr. 2, 1895,	9,050	1.71	-	-	-	-
Needham, ⁶ . . .	478	Nov. 1, 1899,	5,900	1.12	-	-	-	-
Norfolk, ⁷ . . .	88	Sept. 21, 1894,	7,676	1.45	7,676	1.45	-	-
Norfolk, ⁸ . . .	356	July 8, 1897,	21,467	4.07	-	-	-	-
Norwood, . . .	51	July 21, 1894,	18,747	3.55	8,197	1.55	2,625	.50
Quincy, ⁹ . . .	237	Mar. 18, 1896,	9,920	1.88	-	-	2,607	.49
Quincy, ¹⁰ . . .	292	Sept. 17, 1896,	6,650	1.26	-	-	-	-
Randolph, . . .	208	Aug. 3, 1895,	9,050	1.71	-	-	-	-
Sharon, . . .	159	Apr. 12, 1895,	28,713	5.44	-	-	-	-
Stoughton, . . .	228	Jan. 15, 1896,	20,538	3.89	-	-	-	-
Walpole, . . .	77	Aug. 4, 1894,	30,300	5.74	19,369	3.67	-	-
Wellesley, . . .	425	June 22, 1898,	21,120	4.00	-	-	-	-
Westwood, . . .	354	July 2, 1897,	5,659	1.07	-	-	4,300	.82
Weymouth, ¹¹ . . .	59	July 27, 1894,	9,400	1.78	9,237	1.75	-	-
Weymouth, ¹² . . .	63	July 30, 1894,	1,330	.25	1,330	.25	-	-
Weymouth, ¹³ . . .	414	Mar. 28, 1898,	28,090	5.32	-	-	-	-
Wrentham, . . .	32	July 10, 1894,	38,150	7.23	16,040	3.04	-2,946	.56
Totals, . . .			429,489	81.34	69,866	13.23	17,629	3.34

Thirty petitions (two city and twenty-eight town), in one city and twenty-one towns.

Average length petitioned for, 14,316 feet (2.71 miles).

Twenty-nine lay-outs, in one city and nine towns.

Laid out on city petitions, 2,607 feet (.49 mile).

Laid out on town petitions, 84,888 feet (16.08 miles).

Total length laid out, 87,495 feet (16.57 miles); average, 3,017 feet (.57 mile).

Percentage of length laid out to distance petitioned for, 20.37.

¹ Mansfield-Norfolk road.³ Village Street.⁵ Great Plain Avenue.⁷ Providence turnpike.⁹ Washington Street; Weymouth road.¹¹ Bridge Street; Hingham road.¹³ Washington and Main streets.² Village road.⁴ Village, Main and Oakland streets.⁶ Highland Avenue.⁸ Walpole-Franklin road.¹⁰ Randolph Street.¹² Ann Street.

Plymouth County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles	1894-96.		1899.	
					Feet.	Miles.	Feet.	Miles.
Abington, ¹	58	July 27, 1894,	8,700	1.66	-	-	-	-
Abington, ²	192	April 19, 1895,	10,300	1.95	-	-	-	-
Bridgewater,	217	Nov. 14, 1895,	6,800	1.25	-	-	-	-
Brockton, ³	61	July 27, 1894,	5,525	1.05	-	-	-	-
Brockton, ⁴	270	June 22, 1896,	9,860	1.87	6,257	1.18	3,603	.68
Carver, ⁵	325	Mar. 4, 1897,	5,280	1.00	-	-	-	-
Carver, ⁶	438	Dec. 9, 1898,	28,400	5.38	-	-	-	-
Duxbury,	70	July 31, 1894,	33,000	6.25	7,187	1.36	3,663	.69
East Bridgewater,	240	April 8, 1896,	6,300	1.19	-	-	-	-
Halifax,	54	July 24, 1894,	23,463	4.44	-	-	-	-
Hanover,	66	July 30, 1894,	24,157	4.58	-	-	-	-
Hanson, ⁷	262	June 12, 1896,	5,280	1.00	-	-	-	-
Hanson, ⁸	263	June 12, 1896,	5,280	1.00	-	-	-	-
Hingham,	8	July 3, 1894,	27,655	5.24	14,037	2.66	-	-
Lakeville,	174	May 14, 1896,	5,300	1.00	-	-	-	-
Marion,	29	July 10, 1894,	27,248	5.16	10,780	2.04	4,300	.82
Marshfield,	71	July 31, 1894,	40,400	7.65	7,671	1.45	2,893	.55
Mattapoisett,	30	July 10, 1894,	24,992	4.78	6,134	1.17	-	-
Middleborough, ⁹	68	July 31, 1894,	77,169	14.62	14,576	2.76	-	-
Middleborough, ¹⁰	428	June 30, 1896,	32,310	6.12	-	-	-	-
Norwell,	246	May 5, 1896,	5,923	1.12	-	-	-	-
Pembroke,	234	Feb. 27, 1896,	5,280	1.00	-	-	-	-
Plymouth, ¹¹	72	July 31, 1894,	90,420	17.13	7,609	1.42	-	-
Plymouth, ¹²	269	June 22, 1896,	5,846	1.11	5,846	1.11	-	-
Plymouth, ¹³	374	Oct. 11, 1897,	9,130	1.78	6,987	1.32	-	-
Plympton,	121	Jan. 22, 1895,	5,280	1.00	-	-	-	-
Rochester,	172	May 18, 1895,	22,108	4.19	-	-	-	-
Rockland,	75	Aug. 1, 1894,	6,900	1.30	-	-	-	-
Scituate,	69	July 31, 1894,	28,500	5.39	6,139	1.17	-	-
Wareham, ¹⁴	42	July 16, 1894,	60,100	11.38	3,014	.57	-	-
Wareham, ¹⁵	406	Feb. 5, 1898,	18,100	3.43	5,529	1.05	-	-
West Bridgewater,	221	Dec. 4, 1895,	17,100	3.24	-	-	-	-
Whitman,	65	July, 30, 1894,	8,900	1.68	8,957	1.69	-	-
Totals,			653,216	123.71	110,623	20.95	14,459	2.74

Thirty-three petitions (two city and thirty-one town), in one city and twenty-four towns.

Average distance petitioned for, 19,793 feet (3.75 miles).

Forty-three lay-outs, in one city and ten towns.

Laid out on city petitions, 9,860 feet (1.87 miles).

Laid out on town petitions, 115,222 feet (21.82 miles).

Total length laid out, 125,082 feet (23.69 miles); average, 2,978 feet (.56 mile).

Percentage of length laid out to distance petitioned for, 19.15.

¹ Randolph Street.

² Brockton Avenue.

³ Crescent Street.

⁴ Belmont Street.

⁵ Plymouth-Wareham road.

⁶ Embraces former petition.

⁷ Main Street.

⁸ Whitman Street.

⁹ Brockton-Wareham road.

¹⁰ New plan in part of earlier petition.

¹¹ South Shore road.

¹² Pine Hills road.

¹³ Fall River-Cape Cod road.

¹⁴ Onset road.

Suffolk County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-98.		1899.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Chelsea,	56	July 25, 1894,	6,000	1.14	-	-	-	-
Revere, ¹	60	July 27, 1894,	11,475	2.17	-	-	3,525	.67
Revere, ²	346	June 10, 1897,	6,506	1.23	-	-	-	-
Revere, ³	350	June 24, 1897,	3,469	.66	3,045	.58	-	-
Revere, ⁴	407	Feb. 7, 1898,	11,000	2.09	-	-	-	-
Winthrop, ⁵	73	July 31, 1894,	18,100	3.42	-	-	-	-
Winthrop, ⁶	451	Dec. 29, 1898,	2,640	.50	-	-	-	-
Totals, . . . . .	.	.	57,550	10.90	3,045	.58	3,525	.67

Seven petitions (one city, six town), in one city and two towns.

Average distance petitioned for, 8,221 feet (1.56 miles).

Four lay-outs, in one town.

Total length laid out, 6,570 feet (1.24 miles).

Percentage of length laid out to distance petitioned for, 11.42.

¹ Salem turnpike.

² Ocean Avenue.

³ Atlantic Avenue.

⁴ Ocean Avenue extension.

⁵ Revere Street and Crest Avenue.

⁶ Duplication of part of former petition.

Worcester County.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-98.		1899.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Ashburnham,	463	April 17, 1899,	13,200	2.50	-	-	-	-
Athol,	37	July 12, 1894,	16,800	3.18	8,475	1.61	-	-
Auburn,	148	Mar. 30, 1895,	28,095	5.25	12,555	2.38	2,198	.42
Auburn, ¹	433	Aug. 24, 1895,	1,437	.27	-	-	1,437	.27
Barre,	146	Mar. 10, 1895,	15,286	2.89	3,545	.67	3,178	.60
Blackstone, ²	140	Mar. 2, 1895,	7,700	1.46	-	-	3,378	.64
Blackstone, ³	399	Dec. 29, 1897,	12,304	2.33	-	-	-	-
Bolton, ⁴	185	June 3, 1895,	5,300	1.00	-	-	-	-
Bolton, ⁵	472	June 5, 1899,	32,500	6.16	-	-	-	-
Boylston,	398	Dec. 23, 1897,	10,560	2.00	-	-	-	-
Brookfield, ⁶	111	Jan. 2, 1895,	5,972	1.13	-	-	-	-
Brookfield, ⁶	300	Nov. 27, 1896,	22,025	4.17	4,670	.88	-	-
Charlton, ⁷	261	June 11, 1896,	10,900	2.06	-	-	-	-
Charlton, ⁸	389	Dec. 13, 1897,	5,280	1.00	-	-	-	-

¹ Relocation.

² Main Street, from Woonsocket line.

³ Main Street, from Uxbridge line.

⁴ Hudson road.

⁵ Boston-Fitchburg road.

⁶ Springfield-Worcester road.

⁷ Charlton Depot to Charlton City.

⁸ From Oxford line.

Worcester County—Continued.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-98.		1899.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Dana,	294	Sept. 24, 1896,	10,600	2.00	-	-	-	-
Douglas,	284	Dec. 1, 1897,	10,567	2.00	-	-	-	-
Dudley,	391	Dec. 16, 1897,	15,840	3.00	-	-	-	-
Fitchburg, ¹	17	July 5, 1894,	5,493	1.04	5,133	.97	-	-
Fitchburg, ²	62	July 20, 1894,	20,900	3.94	-	-	-	-
Fitchburg, ³	93	Oct. 3, 1894,	10,560	2.00	-	-	-	-
Fitchburg, ⁴	339	May 14, 1897,	5,230	1.00	3,196	.61	-	-
Gardner,	13	July 3, 1894,	29,656	5.62	12,520	2.37	-	-
Grafton,	213	Aug. 15, 1895,	16,971	3.21	4,150	.79	3,050	.58
Hardwick,	207	July 31, 1895,	5,357	1.01	2,052	.39	-	-
Harvard,	260	June 11, 1896,	25,700	4.87	-	-	-	-
Holden, ⁵	10	July 3, 1894,	27,920	5.29	16,690	3.16	-	-
Holden, ⁶	437	Nov. 2, 1898,	9,240	1.75	-	-	-	-
Hopedale, ⁶	144	Mar. 16, 1895,	6,040	1.14	-	-	-	-
Hopedale, ⁷	423	June 20, 1896,	1,760	.33	-	-	-	-
Hubbardston,	232	Feb. 24, 1896,	10,560	2.00	-	-	-	-
Lancaster,	137	Feb. 28, 1895,	24,806	4.70	-	-	-	-
Leicester,	25	July 9, 1894,	23,110	5.32	21,087	4.19	3,593	.68
Leominster,	91	Sept. 29, 1894,	26,400	5.00	-	-	-	-
Lunenburg,	16	July 5, 1894,	30,772	5.83	2,275	.43	3,231	.61
Mendon,	54	Aug. 20, 1894,	18,432	3.49	-	-	-	-
Millbury,	372	Oct. 2, 1897,	19,200	3.67	-	-	-	-
Milford, ⁸	420	June 6, 1898,	9,290	1.76	-	-	-	-
Milford, ⁷	421	June 6, 1898,	5,560	1.05	-	-	-	-
New Braintree,	310	Aug. 6, 1896,	939	.18	920	.17	-	-
Northborough, ⁸	122	Jan. 24, 1895,	3,834	.73	-	-	-	-
Northborough, ⁹	153	April 1, 1895,	11,000	2.06	7,199	1.33	-	-
Northborough, ⁸	373	Oct. 4, 1897,	2,200	.42	2,221	.42	-	-
Northborough, ⁹	465	May 8, 1899,	16,750	3.17	-	-	-	-
North Brookfield,	324	Feb. 25, 1897,	11,913	2.26	-	-	-	-
Oakham,	199	July 11, 1895,	15,045	2.85	-	-	-	-
Oxford, ¹⁰	106	Dec. 24, 1894,	33,550	6.35	-	-	-	-
Oxford, ¹⁰	404	Jan. 25, 1898,	10,560	2.00	-	-	-	-
Paxton,	33	July 10, 1894,	23,500	5.40	17,116	3.24	-	-

¹ Westminster road.² Ashby road.³ Leominster road.⁴ Lunenburg road.⁵ Worcester-Gardner road.⁶ Milford-Mendon road.⁷ Milford-Upton road.⁸ Westborough Hospital road.⁹ Worcester-Marlborough road.¹⁰ Worcester-Webster road.

Worcester County — Continued.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-95.		1899.	
					Feet.	Miles.	Feet.	Miles.
Petersham, . . .	296	Oct. 23, 1896,	23,744	4.49	-	-	-	-
Phillipston, . . .	14	July 3, 1894,	17,500	3.31	6,301	1.19	-	-
Princeton, ¹ . . .	193	June 23, 1895,	14,231	2.69	2,002	.49	-	-
Princeton, ² . . .	452	Dec. 29, 1898,	5,730	1.09	-	-	-	-
Royalston, . . .	302	Dec. 7, 1896,	23,195	4.39	-	-	-	-
Rutland, ³ . . .	141	Mar. 5, 1895,	24,581	4.65	-	-	-	-
Rutland, ⁴ . . .	142	Mar. 5, 1895,	24,268	4.59	-	-	-	-
Shrewsbury, ⁵ . . .	21	July 6, 1894,	11,000	2.08	11,000	2.08	-	-
Shrewsbury, ⁵ . . .	308	Jan. 6, 1897,	4,092	.78	4,092	.78	-	-
Shrewsbury, ⁵ . . .	394	Dec. 23, 1897,	2,800	.53	825	.16	1,975	.37
Shrewsbury, ⁵ . . .	429	July 11, 1898,	10,550	2.00	-	-	370	.07
Southborough, ⁶ . . .	161	April 18, 1895,	5,300	1.00	-	-	-	-
Southborough, ⁷ . . .	447	Dec. 20, 1898,	5,440	1.03	-	-	-	-
Southbridge, . . .	403	Jan. 13, 1898,	9,846	1.86	-	-	-	-
Spencer, ⁸ . . .	49	July 19, 1894,	23,418	4.44	2,276	.43	-	-
Spencer, ^{8,9} . . .	320	Feb. 19, 1897,	5,230	1.00	-	-	-	-
Sterling, ¹⁰ . . .	163	May 1, 1895,	5,280	1.00	4,034	.76	-	-
Sterling, ¹⁰ . . .	318	Feb. 18, 1897,	5,280	1.00	-	-	-	-
Sterling, ¹¹ . . .	319	Feb. 18, 1897,	12,882	2.44	-	-	-	-
Sterling, ¹⁰ . . .	358	July 8, 1897,	500	.09	-	-	-	-
Sterling, ¹⁰ . . .	396	Dec. 23, 1897,	10,091	1.91	2,307	.53	-	-
Sturbridge, . . .	169	May 7, 1895,	12,600	2.39	3,094	.59	-	-
Sutton, ¹² . . .	85	Aug. 25, 1894,	6,096	1.16	-	-	-	-
Sutton, ¹² . . .	385	Dec. 1, 1897,	7,770	1.47	-	-	2,599	.49
Templeton, . . .	86	Sept. 1, 1894,	31,668	6.00	-	-	3,300	.63
Upton, . . .	305	Dec. 18, 1896,	27,443	5.20	-	-	-	-
Uxbridge, ¹⁴ . . .	89	Sept. 28, 1894,	15,759	2.99	6,717	1.23	-	-
Uxbridge, ¹⁵ . . .	379	Nov. 2, 1897,	6,140	1.17	-	-	-	-
Warren, ⁵ . . .	15	July 5, 1894,	28,020	5.31	9,978	1.89	-	-
Warren, ¹⁶ . . .	39	July 16, 1894,	18,868	3.57	-	-	3,000	.57
Webster, . . .	392	Dec. 16, 1897,	7,700	1.46	-	-	-	-
Westborough, ¹⁷ . . .	160	April 14, 1895,	1,100	.21	1,100	.21	-	-

¹ Princeton Depot road.² Sterling road.³ Holden road.⁴ Worcester-Athol road.⁵ Worcester-Marlborough road.⁶ Framingham road.⁷ Westborough road.⁸ Springfield-Worcester road.⁹ Duplicate of portion of previous petition.¹⁰ Worcester-Fitchburg road.¹¹ Lancaster road.¹² Grafton road.¹³ Worcester road.¹⁴ Blackstone road.¹⁵ Mendon road.¹⁶ To Connecticut line.¹⁷ Westborough Hospital road.

Worcester County — Concluded.

COUNTY, CITY OR TOWN.	No.	Petition Received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
			Feet.	Miles.	1894-95.		1899.	
					Feet.	Miles.	Feet.	Miles.
Westborough, ¹ . . .	306	Dec. 30, 1896,	5,300	1.00	-	-	-	-
Westborough, ² . . .	371	Sept. 27, 1897,	2,579	.49	2,579	.49	-	-
Westborough, ² . . .	401	Jan. 10, 1898,	6,048	1.15	-	-	-	-
Westborough, ¹ . . .	475	June 18, 1899,	34,320	6.50	-	-	-	-
West Boylston, ² . . .	310	Jan. 15, 1897,	6,100	1.16	6,100	1.16	-	-
West Boylston, ² . . .	369	Sept. 22, 1897,	3,900	.74	2,100	.40	-	-
West Brookfield, ⁴ . . .	222	Dec. 5, 1896,	800	.15	-	-	800	.15
West Brookfield, ⁵ . . .	312	Jan. 25, 1897,	13,350	2.53	-	-	2,300	.44
West Brookfield, ⁵ . . .	382	Nov. 12, 1897,	5,280	1.00	-	-	-	-
Westminster, . . .	23	July 9, 1894,	30,597	5.79	14,230	2.70	1,595	.30
Winchendon, . . .	317	Feb. 17, 1897,	8,861	1.68	-	-	-	-
Worcester, ⁶ . . .	162	April 22, 1895,	7,636	1.44	7,157	1.35	-	-
Worcester, ⁷ . . .	327	Mar. 4, 1897,	12,155	2.30	3,486	.66	-	-
Worcester, ⁸ . . .	328	Mar. 4, 1897,	20,445	3.87	-	-	-	-
Totals, . . .	.	.	1,251,639	237.03	215,292	40.78	36,004	6.82

Ninety-four petitions (seven city and eighty-seven town), in two cities and fifty-four towns.

Average distance petitioned for, 13,392 feet (2.54 miles).

Eighty-six lay-outs, in two cities and twenty-eight towns.

Laid out on city petitions, 18,972 feet (3.60 miles).

Laid out on town petitions, 232,324 feet (44.00 miles).

Total length laid out, 251,296 feet (47.60 miles); average, 2,922 feet (.55 mile).

Percentage of length laid out to distance petitioned for, 19.97.

¹ Southborough-Grafton line.

² Worcester-Fitchburg road.

³ Springfield-Worcester road.

⁷ Holden road.

² Westborough Hospital road.

⁴ Ware road.

⁶ Worcester-Athol road.

⁸ Worcester-Gardner road.

Summary of Lengths petitioned for and laid out, by Counties, together with Percentage of Lengths laid out to Lengths petitioned for.

COUNTIES.	LENGTHS PETITIONED FOR.		LENGTHS LAID OUT.						Percentage.
			1894-95.		1899.		TOTAL.		
	Feet.	Miles.	Feet.	Miles.	Feet.	Miles.	Feet.	Miles.	
Barnstable, .	377,023	71.41	116,114	21.99	12,814	2.43	128,928	22.42	34.19
Berkshire, . .	463,044	87.70	86,454	16.37	16,635	3.15	103,089	19.52	22.26
Bristol, . .	491,584	98.10	81,922	15.51	13,193	2.50	95,115	18.01	19.35
Dukes, . .	119,635	22.66	39,437	7.47	1,551	.29	40,988	7.76	34.26
Essex, . . .	680,904	128.96	82,155	15.56	23,596	5.42	110,751	26.98	16.27
Franklin, . .	410,530	77.75	72,891	13.80	14,891	2.82	87,782	16.63	21.40
Hampden, . .	423,368	81.13	74,137	14.04	25,087	4.76	99,224	18.80	23.15
Hampshire, .	294,590	55.79	62,484	11.83	9,821	1.86	72,305	13.69	23.21
Middlesex, .	1,143,388	216.55	135,151	25.60	39,741	7.53	174,892	33.12	15.12
Nantucket, . .	34,185	6.47	22,270	4.23	1,320	.25	23,590	4.48	69.01
Norfolk, . .	429,489	81.34	69,866	13.23	17,629	3.34	87,495	16.57	20.37
Plymouth, . .	653,216	123.71	110,623	20.95	14,459	2.74	125,082	23.69	19.15
Suffolk, . .	57,550	10.90	3,045	.58	3,525	.67	6,570	1.24	11.42
Worcester, . .	1,251,539	237.03	215,292	40.78	36,004	6.82	251,296	47.60	19.97
Totals, . .	6,835,045	1,294.52	1,171,841	221.94	235,266	44.56	1,407,107	266.50	20.59

Laid out on county petitions, 324,623 feet (61.46 miles).

Laid out on city petitions, 123,857 feet (23.46 miles).

Laid out on town petitions, 958,727 feet (181.58 miles).

Average distance petitioned for, 14,240 feet (2.70 miles).

Average length laid out, 3,212 feet (.61 mile).

Statement showing Number of County, City and Town Petitions, Distribution of Petitions among Municipalities, and Number of Cities and Towns in which Lay-outs have been made, by Counties.

COUNTIES.	PETITIONS RECEIVED.				PETITIONS SITUATED IN —			LAY-OUTS MADE IN —			Number of Lay-outs.
	County.	City.	Town.	Total.	Cities.	Towns.	Total.	Cities.	Towns.	Total.	
Barnstable, . . .	-	-	22	22	-	12	12	-	9	9	31
Berkshire, . . .	16	5	28	49	2	22	24	2	10	12	31
Bristol, . . .	1	4	21	26	2	16	18	1	7	8	27
Dukes, . . .	2	-	4	6	-	5	5	-	4	4	9
Essex, . . .	2	15	29	46	7	24	31	6	10	16	31
Franklin, . . .	1	-	38	39	-	16	16	-	12	12	32
Hampden, . . .	4	1	15	20	2	15	17	1	8	9	33
Hampshire, . . .	1	3	27	31	1	17	18	1	8	9	27
Middlesex, . . .	8	10	58	76	5	42	47	2	18	20	47
Nantucket, . . .	-	-	1	1	-	1	1	-	1	1	8
Norfolk, . . .	-	2	28	30	1	21	22	1	9	10	29
Plymouth, . . .	-	2	31	33	1	24	25	1	10	11	43
Suffolk, . . .	-	1	6	7	1	2	3	-	1	1	4
Worcester, . . .	-	7	87	94	2	54	56	2	28	30	86
Totals, . . .	35	50	305	480	24	273	297	17	135	152	438

INDEX.

A.

	PAGE
Acts and Resolves previous to 1900,	117
Appropriations,	7, 13
Assessments, county,	12

B.

Brick paving,	84
Bridges,	31

C.

Chief engineer, report of,	29
Cities and towns in which work was done during 1899,	98
Claims,	25
Commission, legislation recommended concerning organization of,	15
Completed roads approved during 1899,	110
Construction, expenditures for,	17
Construction, nature of,	42
Contracts,	8, 10, 14
Contracts, delays in completing,	8
Contracts, liquidated damage clause in,	8
Contracts made during 1899,	11, 104
Contracts, number of,	11
Contract prices, table of,	104
Cost per standard mile of road,	150
County assessments,	12
County hearings,	9

D.

Delays in construction,	8
Desirable properties of road materials,	68
Deterioration of roads, causes of,	62
Distribution of State roads,	113

E.

Engineer, chief, report of,	29
Engineers, resident, employed on construction during 1899,	98
Estimates for 1900,	13
European roads,	13, 57
Expenditures for construction,	17
Expenditures for office expenses,	24

	PAGE
Expenditures for road machinery,	24
Expenditures for relocation of street railways,	24
Expenditures for repairs and maintenance,	20, 159
Expenditures for salaries, office expenses, etc., during 1899,	24
Expenditure per standard mile of road,	150
Experiment with oil to lay dust,	35

G.

Geologist's report,	13, 56
Gravel roads,	32

H.

Hearings,	9
Highways (see State highways).	

L.

Lay-outs made,	7
Lay-outs made, table of,	166
Lay-outs, legislation concerning modification of,	14
Lay-outs, width of,	42
Legislation previous to 1900,	117
Legislation recommended,	14
Letter of transmittal,	3
Liquidated damages,	8
Local stone, use of,	33

M.

Macadam, widths of,	37, 42
Maintenance (see Repairs).	
Materials, measurement of,	33
Meetings of commission,	9

O.

Office expenditures,	24
Officers of the commission,	5
Oil, experiment with, to lay dust,	35

P.

Paving brick,	84
Petitions,	11
Petitions received, table of,	166
Physical properties of road materials,	61
Prices, contract, table of,	104

R.

Relocation of street railways, expenditures for,	24
Repairs and maintenance, table showing cost of,	159
Repairs, expenditures for,	20

	PAGE
Repairs, legislation recommended concerning assessment of cost of,	14
Repairs made,	31
Repairing of roads,	68
Report of chief engineer,	29
Report of geologist,	13, 56
Resident engineers, list of, employed during 1899,	98
Road machinery, expenditures for,	24
Roads (see State highways).	
Roads, European,	13, 57
Roads, repairing of,	68
Road materials and their physical properties,	61
Road materials, desirable properties of,	68
Road materials, laboratory tests of,	73
Road materials, laboratory tests of, in other countries,	85
Road materials, table of laboratory tests of,	88
Road materials, tests of, in actual use,	86
Road materials, tests of, in France,	73
Road materials, tests of, in Portugal,	78
Road materials, tests of, in United States,	79

S.

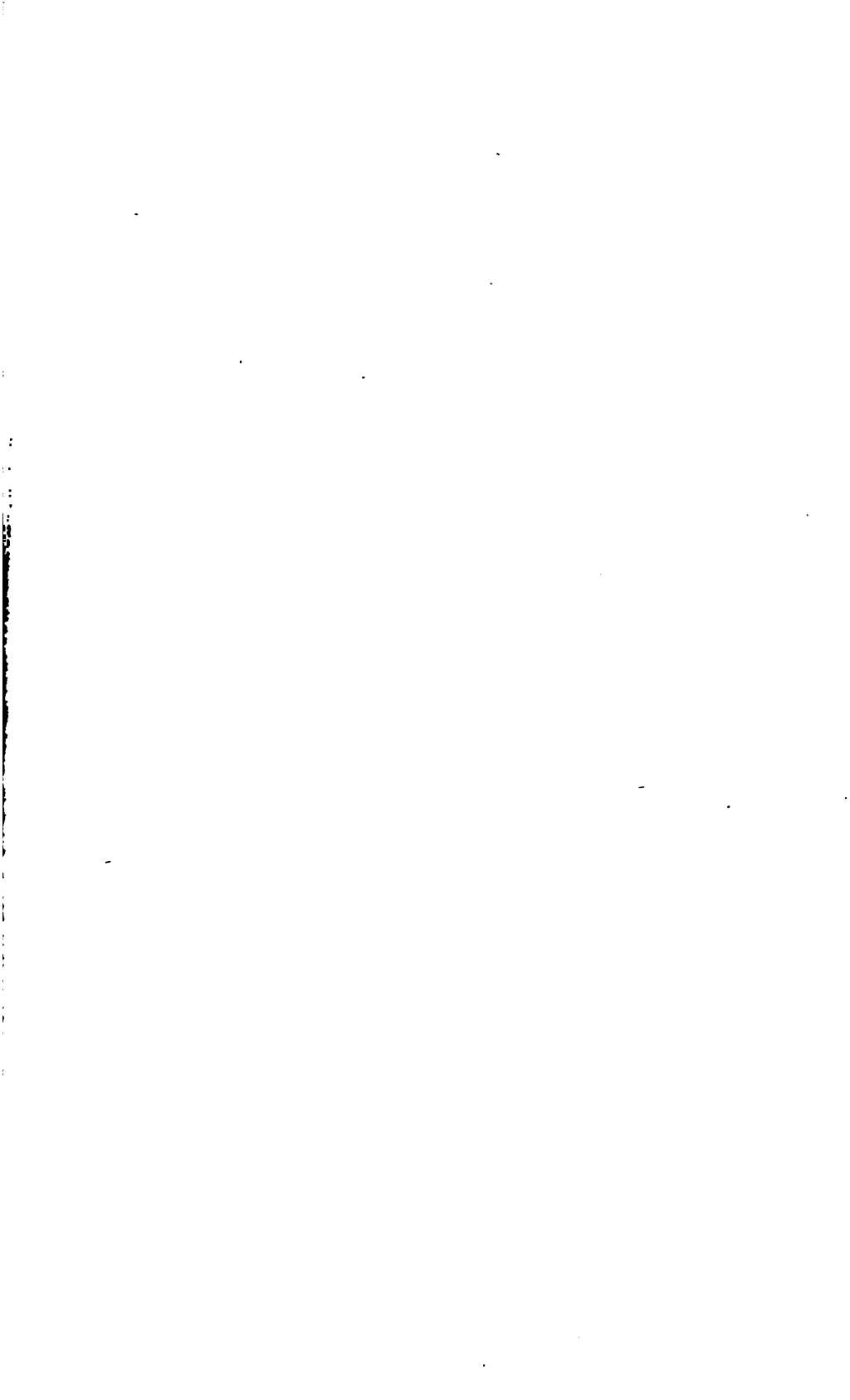
Standard mile, cost per,	150
State highways completed and accepted in 1899,	110
State highways constructed or contracted for,	42
State highways, distribution of,	113
State highways laid out,	166
State highways laid out and completed,	7
State highways, miles of, constructed,	42
State highways, miles of, constructed in 1899,	7
State highways, miles of, laid out in 1899,	7
State highway locations, widths of,	42
Stone tests,	88
Stone, values of various kinds of,	33
Street railways,	11
Street railways, expenditures for relocation of,	24
Surveys made,	30

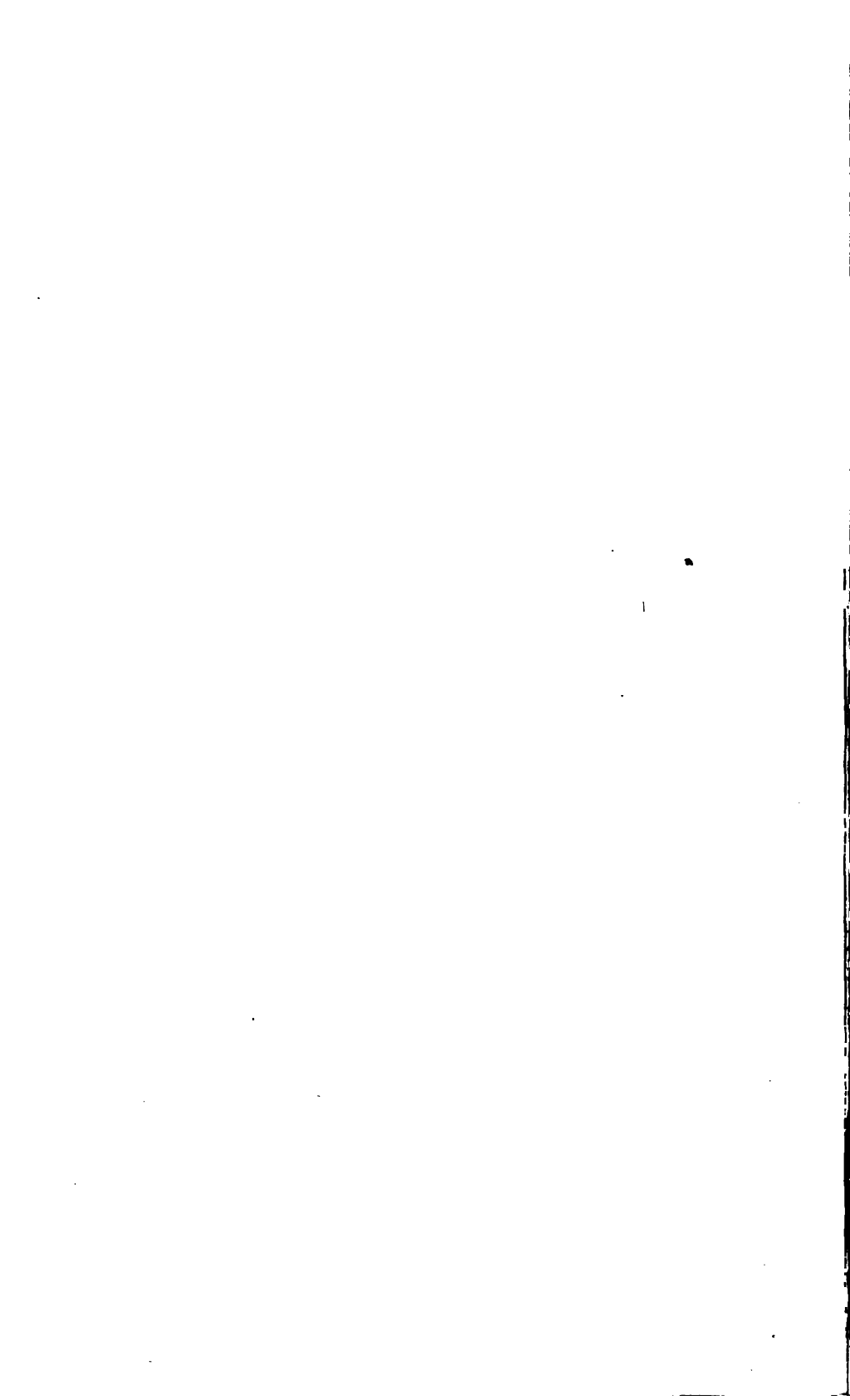
T.

Tests of road materials in actual use,	86
Tests of road materials in France,	73
Tests of road materials in Portugal,	78
Tests of road materials in United States,	79
Tests of stone, table of,	88
Towns and cities in which work was done during 1899,	98
Trap rock, use of,	33
Travelled way, widths of,	37

W.

Widths of macadam or gravel surface,	42
Width of road locations,	42
Widths of travelled way, table showing,	37
Work done, quantities of,	30

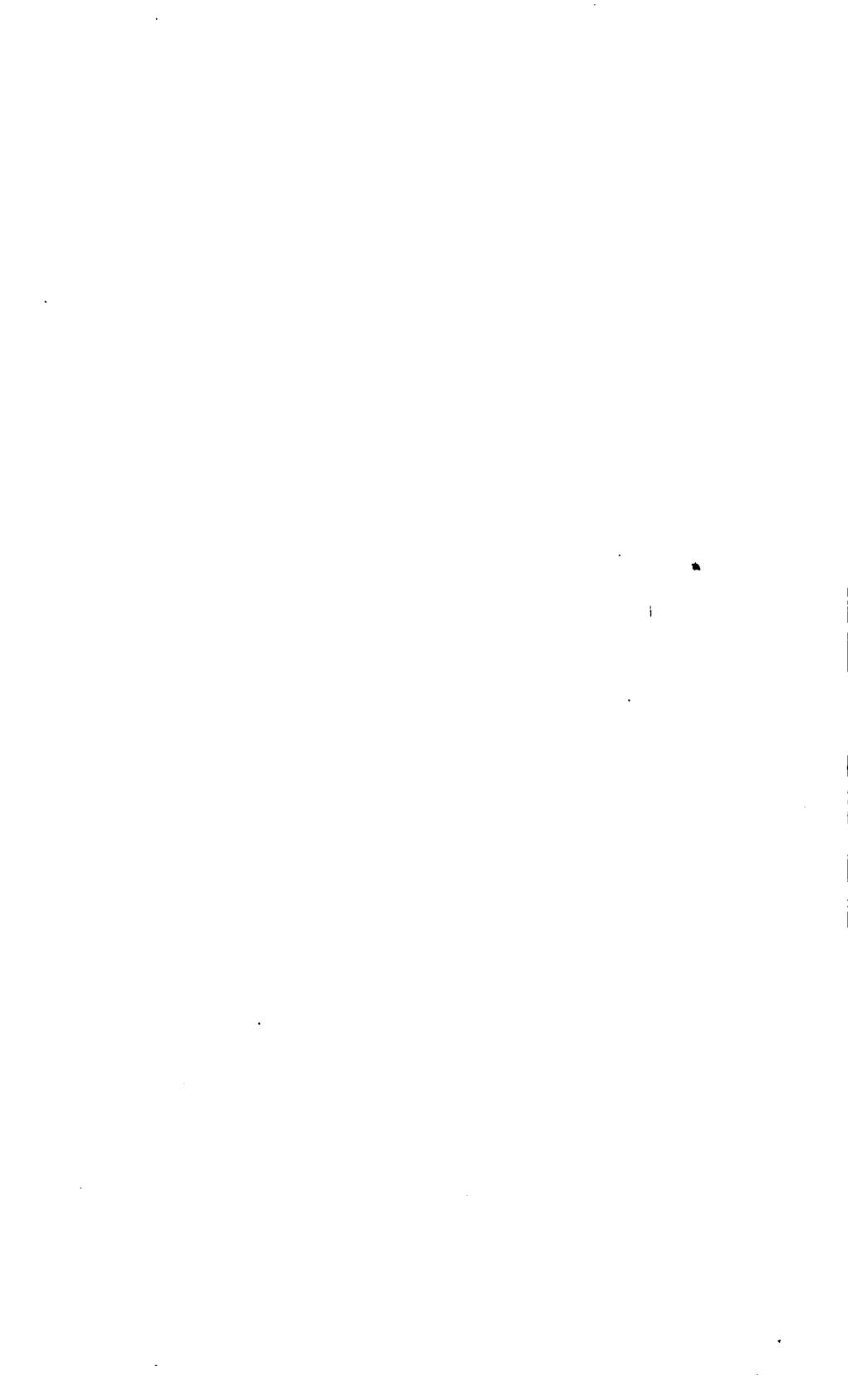


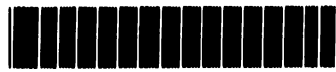




3 2044 029 298 981

HE
355
Mass
V400 1879
copy 2





3 2044 029 298 981

HE
355
Mass
V406 1899
copy 2

